March 1990

Federal Water Policy

A Progress Report

Interdepartmental Committee on Water

Government of Canada / Gouvernement du Canada

FEDERAL WATER POLICY

A PROGRESS REPORT

INTERDEPARTMENTAL COMMITTEE ON WATER

OTTAWA
MARCH 1990

91-00628/

Published by authority of
the Minister of the Environment

Printed on paper that contains recovered waste

Ottawa, Ontario
K1A 0H3

The Honourable Robert R. de Cotret
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Sir:

As required under the Federal Water Policy I hereby submit, on behalf of the federal Interdepartmental Committee on Water, the first report on progress in implementing that Policy.

The report covers the period November 1987 to April 1990.

Respectfully submitted,

D. A. Davis

Peter Higgins
A/Chairperson
Interdepartmental Committee on Water

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PROGRESS REPORT HIGHLIGHTS

	DETAILS IN:
• *Canadian Environmental Protection Act* (CEPA) passed in June 1988, which provides for a comprehensive, life-cycle approach to the management of toxic chemicals.	II.1.1
• The Great Lakes Action Plan, allocating an additional $125 million of federal funds to multiparty efforts to clean up the Great Lakes and study the human health effects of Great Lakes contaminants, was announced in October 1989.	II.16.3
• Lake Ontario Toxic Management Plan was released in January 1989.	II.16.1
• St. Lawrence River Action Plan commits $110 million over the next five years as the federal share for cleanup and protection of the St. Lawrence River.	II.7.3
• North American Waterfowl Management Plan recently received $30 million in new federal funds for water-fowl habitat restoration and protection.	II.10.6
• Water quality agreements have been signed between Department of Environment (DOE) and six provinces. The two territories, in co-operation with Department of Indian Affairs and Northern Development (DIAND), have also concluded negotiations with DOE.	II.2.1
• Draft guidelines in support of the "no net loss" fish habitat principle were prepared, as well as draft compliance and enforcement policies for sections 35 and 36 of the *Fisheries Act* (FA).	II.4.1
• A Federal Policy on Wetland Conservation together with implementation plans was prepared and is expected to be finalized in 1990.	II.10.1
• Nominations under the Canadian Heritage Rivers System (CHRS) now stand at eighteen, of which nine have been designated.	II.13.1
• British Columbia and Alberta became the eighth and ninth provinces to join the national Flood Damage Reduction (FDR) Program.	II.20.1
• Consultations are under way on the draft bill to amend the *Northern Inland Waters Act* (NIWA), which is the federal statute for water resource management in the Yukon and Northwest Territories.	II.14.3
• Significant technological developments include DOE's innovation to convert sewage sludge to oil.	II.25.2

- Northern Water Studies Program was initiated in 1988 by DIAND to enhance northern water science and policy. II.24.1

- CCME adopted Statement on International Co-operation on Environmental Matters. II.17.1

RECOMMENDATIONS

As work on the implementation of the Federal Water Policy (FWP) proceeds, the need for refinements to the policy statements will become evident. While some departments have already suggested minor adjustments, the Committee feels that sufficient time has not yet elapsed for consideration of changes to the Policy as issued in 1987. The suggestions have been filed with the Interdepartmental Committee on Water (ICW) Secretariat and will be considered when the second progress report is developed.

While the Committee is of the opinion that all departments are fully committed to the successful implementation of the Policy and that for the most part successful progress is being made, there are some areas that require special mention.

The Committee recommends that:

- The federal government explore, through its own research and in consultation with the provinces, the full range of economic strategies that could be applied to promote more efficient, nonpolluting use of water.

- The federal government continue to strengthen its own research programs on water issues of national and regional significance, integrating natural and social science approaches and working in co-operation with others in the scientific community as far as possible.

- The federal government develop alternatives to replace the Department of Supply and Services (DSS) Unsolicited Proposals Program and the DOE Water Resources Research Subventions Program (WRRSP) that would encourage private-sector and university water-related research and technology development.

- The federal government encourage better integration of water quantity and quality data collection and analysis in support of sustainable development decision making and state of the environment reporting with particular emphasis given to improving water monitoring capabilities north of 60°.

- DOE develop and put into effect, in consultation with other departments, co-ordinated strategies for the sustainable development of ground-water resources and surface resources dependent on ground water.

- A federal program be implemented both to assess the problem of aquatic debris and its impact and to reduce the extent of such debris.

- The ICW be used as a forum for improving integrated decision making at the federal level for policies and programs that may affect water.

- The federal government continue to encourage the activities of the national and provincial Round Tables to assist in the identification and resolution of potential conflicts or inconsistencies that may arise in water management policies and practices among all sectors.

- Outstanding water legislation initiatives (*Northern Inland Waters Act* [NIWA], the *Navigable Waters Protection Act* [NWPA], National Health and Welfare's proposed Drinking Water Safety Act, the *International River Improvements Act* [IRIA], the *Canada Water Act* [CWA] and the Canada Water Preservation Act/Bill C-156) proceed at the earliest opportunity.

- In consolidating and updating its legislative base, DOE should ensure that a clear federal commitment be made to sustainable development and an ecosystem approach to water management. Updated legislation should be considered in the broader environmental context and incorporate the FWP principles of beneficiary/polluter pays and a fair value for water.

- A federally co-ordinated water awareness program be implemented to encourage Canadians to use water in an efficient and nonpolluting manner.

- Reporting on the implementation of the FWP be carried out every 2 years rather than annually.

INTRODUCTION

SETTING THE STAGE

This document is composed of two parts. The first will provide the reader with background information on the Federal Water Policy (FWP) and the process which was followed by the Interdepartmental Committee on Water (ICW) in developing this report to the Minister of the Environment. A complete review of achievement under the five strategies which support the FWP follows, and culminates in a presentation of new directions to better support the Policy. The second part of this report contains a detailed review of the various policy statements which are enunciated under the twenty-five policy concerns contained in the FWP. An effort was made to provide the reader with a thorough review of the actions taken by the federal government in support of the FWP.

THE FEDERAL WATER POLICY AT A GLANCE

The FWP is a statement of the federal government's philosophy and goals for the nation's freshwater resources and of the proposed ways of achieving them. It recognizes that water is vital, the lifeblood of the Canadian society, yet is overused and abused. The FWP underlying theme is that Canadians must view water not only as a key to environmental health, but also as a commodity which has a real value and must be managed accordingly.

The overall objective of the FWP, which is to encourage the wise use of the resource consistent with the socio-economic and environmental needs, is supported by two specific goals. The first one spells out the need for protecting and enhancing the quality of our water. The second one acknowledges the real value of water and calls for the wise and efficient management and use of the resource.

Five strategies (water pricing, science leadership, integrated planning, legislation and public awareness) are central to the FWP and are the broad courses of action which most consistently apply across the whole spectrum of water concerns in Canada. They define a supportive, yet flexible, role for the federal government and enable partnerships to meet the challenge in Canadian water resources management.

Finally, the FWP contains statements of specific policy related to water concerns. The purpose of the statements is to demonstrate the application of the policy strategies in relation to selected areas of federal concern. The twenty-five concerns are presented in Part II of this report.

CO-OPERATION – THE KEY TO SUCCESSFUL IMPLEMENTATION OF THE FWP

The FWP was received with a great deal of interest by provincial and territorial governments. Although federal positions are not endorsed on all issues, the overall initiative was welcomed as a positive contribution to Canadian water management.

The Canadian Council of Ministers of the Environment (CCME) considered the potential of building on this policy toward a statement of national water policy. Before proceeding any further, however, the CCME's Water Advisory Committee (WAC) was asked to undertake two interim tasks: reviewing the state of water policy formulation and compatibility of approaches to pricing, planning and legislation among member governments; and drafting a statement of national principles for water management from which each government could draw in preparing its own policies.

The release of the FWP has already had an impact on provincial/territorial water policy formulations. Manitoba held hearings in early 1989 on its draft water policy, and the government of the Northwest Territories has also proceeded through two drafts of its policy statement. Both appear to be compatible with the federal policy. Other governments have taken initiatives in specific policy areas advocated by the federal policy. Ontario moved, in early 1989, to legislate against water export, and, more recently, to consult with other governments and interest groups on water-use charges. In mid-1989, New Brunswick appointed an advisory group to develop recommendations on policies related to water quality.

The Policy continues to provide the framework within which all Canadian water management decisions should be taken, whether nationally or internationally. Involvement in international or multinational activities by Canadian officials continues to be guided by the Policy's commitment to work with other countries in addressing global environmental concerns and to provide resource management assistance to other countries.

THE PROCESS LEADING TO THE DEVELOPMENT OF THE FIRST REPORT ON THE IMPLEMENTATION OF THE FWP

The Policy was never perceived as a static document, but rather one which would evolve in keeping with changing priorities and popular viewpoints. Implementation and evaluation of the FWP, therefore, is aimed at the longer term and will ensure that future generations are spared the risks of short-term expediency in the water field.

The FWP assigned to the ICW the responsibility of reporting annually on the overall implementation of the policy, on its strength and weaknesses and on areas of further examination. In order to carry out this task, and keeping with the partnership at the federal level in water management, the ICW established a working group to advise on progress on all aspects of the Policy. The format under which the information is presented is consistent with the FWP document. Findings, conclusions and recommendations contained in this report were fully dicussed at a committee meeting of the ICW.

PART I: STRATEGIES AND DIRECTION

The FWP proposed five strategies to meet its stated goals. These broad courses of action were developed and adopted as the most suitable tools for use by departments in addressing a range of water concerns. These strategies were not put forward as panaceas, and it was recognized at the time the FWP was released that they would need to be tailored over time to better adapt to the challenges water managers were facing. Before proceeding with an analysis of each strategy and linking progress activities with the present-day situation, a short summary of the strategy is provided as well as a specific account of realization under each strategic element as outlined in the FWP. Proposals for future direction conclude the analysis of each strategy.

1. WATER PRICING*

1.1 Progress

The FWP observed that water resources have traditionally been taken for granted, undervalued, and as a result, been overused and abused. One of the solutions suggested by the Policy to overcome the resultant environmental and economic/fiscal problems was the use of realistic water pricing to ensure that water has a fair value and that its conservation becomes a more important consideration in future decision making. The water-pricing strategy applies to both water supply and waste treatment areas of water management.

Water prices are mainly established by provincial and local governments, which makes this a challenging strategy for the federal government to put into action. Significant steps have been taken, however, to implement this strategy largely through strong federal commitment to the user-pays policy, through research in pricing guidelines and other demand management strategies, and through ongoing communication with provinces and municipalities as outlined below.

1.1.1 endorse the concept of realistic pricing as a direct means of controlling demand and generating revenues to cover costs

Progress toward realistic pricing is best illustrated by the consistent federal response to demands for federal financial participation in municipal infrastructure repair and upgrading. This response, expressed through numerous statements and presentations by federal officials, suggests that the user should pay the cost of these needed improvements. The impact has been substantial.The idea has gained acceptance among water management professionals (including those engaged in public utilities) and by the general public, which appears to understand inherently the importance of the user-pays principle.

The water-pricing strategy marks a significant divergence from traditional water management policies in Canada which are essentially based on supply management. A major impediment to its adoption is a perceived need to keep water prices low, not only to minimize tax-like burdens to individual consumers, but also to attract industry. On the other hand, when the concept is presented effectively, e.g. by explaining the need to raise sufficient funds for system maintenance, the general public seems to be in sympathy with more realistic water pricing. This suggests the need for further communication to the public of the need for realistic pricing.

Municipalities are at least beginning to discuss the need for more realistic water prices to ensure infrastructure renewal. Revised water prices have been instituted or studies leading to revised prices have been undertaken in several municipalities.

1.1.2 develop new water-efficient technologies and industrial processes that minimize costs, and encourage water conservation and improved water quality

The federal government has taken a step towards encouraging more water-efficient technology through the compilation of inventories of water-efficient techniques and the publication of a state-of-the-art review of water demand management, which outlines available technology and research needs. To date, no significant effort has been aimed at technology development; however, DOE's Ontario Region Water Infrastructure Working Group is in the planning stage of a pilot project to implement water-efficient technology in a federal building. This initiative is aimed at demonstrating the practicality and efficacy of various water conservation measures and reflects strong employee interest in federal leadership by example.

* Defined here as pricing water in such a way that the full cost of both intake and discharge delivery and treatment is borne by users of the service.

1.1.3 **undertake, support and promote joint federal-provincial examination of the costs and pricing of water for both consumptive and non-consumptive water uses**

This commitment met with strong support from the CCME and led to the publication and distribution of a brochure (and technical report) on municipal water pricing in Canada. Further data collection and research on this issue are under way, and an increase in information dissemination is planned.

For municipalities to price water realistically, it is essential to meter water use. The Canadian Water and Wastewater Association (CWWA) was among the first to recognize this need. With funding provided by DOE, the CWWA completed a study on metering. Its manual entitled "Meters Made Easy" is available. DOE is also supporting a CWWA project aimed at developing guidelines for setting appropriate rates for water and wastewater services.

Data on water costs in Canadian industry were collected in a joint study conducted by DOE, Statistics Canada and some provinces. Analysis of these data is being carried out by DOE and will give indications of industrial responsiveness to water prices, which is key to future policy decisions in the industrial water-use field.

1.1.4 **encourage the application of pricing and other strategies, such as the beneficiary/polluter pays concept, to encourage efficient water use**

The Prairie Farm Rehabilitation Administration (PFRA), the federal agency most concerned with the development of irrigation, increased the delivery charge for irrigation water on its projects in 1988 and again in 1989. This delivery charge recovers a portion of the operating costs and reflects the highly variable supply of water in the region. Charges are being re-examined as one element of the program evaluation currently under way.

A recent survey shows that industrial water withdrawals have fallen over the 1981-1986 period. The cause of this decrease is uncertain, but any trend toward more efficient water use will be reinforced by the water-pricing strategy of the FWP.

Similarly, the federal policy on realistic pricing seems to be encouraging provinces (e.g. Ontario and Alberta) to consider water-pricing policies as a means of water conservation.

Progress has been made towards the implementation of the polluter-pays principle since this concept has been given legislative authority in the *Canadian Environmental Protection Act*. It is too early to assess the effect that this has had on encouraging more efficient water use.

1.2 Analysis and Future Direction

The primary target for pricing to date has been municipal water use. Although municipal water use constituted only 16 percent of water consumed in Canada in 1981, the infrastructure for water supply and wastewater systems represents a tremendous investment. The cost of maintaining and upgrading this infrastructure is not currently being borne fully by the users. Although the federal government recognizes that substantial improvements are now needed to provide adequate municipal water, wastewater and drainage systems in Canada, the government remains committed to the user-pays principle. Current estimates indicate that doubling municipal water prices in Canada would generate sufficient income within five years to adequately upgrade municipal infrastructure.

Realistic pricing will not only help to generate revenue for upgrading infrastructure, but will also help to establish the value of clean water and therefore influence decisions to protect the quality of water.

Another target for realistic pricing has been agricultural water use. In 1981, water consumption in agriculture was 62 percent of total water consumption in Canada. Irrigation consumes more water than any other use in Canada, but costs of irrigation are heavily subsidized. Like many water-pricing issues, however, the problem is broader than simply relating agricultural benefits to the cost of supplying the water. Other regional socio-economic factors must be considered when irrigation is proposed, including the long-term costs of water quality and quantity protection.

This problem points to the fundamental difficulty of establishing the real value of water, including its intrinsic value. It is a significant challenge to

establish a true value for water given that for many of its uses there is no real substitute. Not only is water rarely traded in competitive markets in Canada, its value for many uses, such as recreation, aesthetics and culture, cannot be calculated in conventional economic terms. Thus, pricing alone cannot be relied on to adequately express the value of water. Yet, if sustainable use of water is to be achieved, we must not only be able to compare the value of water in various uses today, but also be able to consider its value to future generations.

Establishing the real value will require us to be able to assess and compare the benefits and costs of the full spectrum of water uses, although not necessarily in conventional economic terms. The federal government can play a role in this area through research and development in the areas of decision-making models that assist tradeoff analyses and of economic strategies beyond pricing.

Other economic strategies beyond pricing can be used to influence both water conservation and quality. The polluter-pays principle is a broad concept that is supported by the federal government in legislation (CEPA), but to date the full range of economic instruments to implement this principle has not yet even been explored. Discharge taxes and other financial incentives and disincentives could be applied to realize the polluter-pays concept. Examples from other countries indicate that much more could be done in terms of making greater use of economic instruments to internalize the costs of (and therefore reduce) water pollution, to promote more efficient water use, and to stimulate more efficient and innovative industrial processes as opposed to end-of-pipe technologies. Examples that could be explored include privatized water and wastewater systems and tradeable water rights. Substantial research and discussion will be required if Canadian legal and financial systems are to accommodate some of these economic instruments.

Structural measures that go hand in hand with economic tools to achieve sustainable water use must also be considered. Metering and water-efficient technology have already been recognized by the federal government as structural improvements that are tied to economic instruments. Another potential structural improvement used elsewhere is the requirement that a discharge pipe be located upstream from the intake pipe. As a direct implementation of the polluter-pays concept, this internalizes the costs of pollution.

In the future, the federal government intends to play an active leadership role in exploring and expanding the use of economic and associated strategies beyond pricing that are consistent with its aim of realistic valuation of water. At the present time, exploration of other strategies has been limited by the availability of staff and financial resources.

Information:
Water Planning and Management Branch
Inland Waters Directorate
Environment Canada
(819) 953-3478

2. SCIENCE LEADERSHIP

2.1 Progress

Scientifically sound knowledge acquired through reliable data and research is fundamental to effective water management decisions and requires the co-operation of all responsible jurisdictions, including the private sector. Our research skills are being increasingly challenged as water management problems grow in complexity and number. Sustainable development requires both an understanding of the socio-economic factors that govern the management of water as a commodity and a knowledge of the natural processes of aquatic ecosystems. Most of the unresolved research issues facing Canada today, for example, climate change and toxic contamination, require an interdisciplinary approach, strong communication between scientists and decision makers, both in government and private sectors, and co-operation on an international level.

2.1.1 conduct and encourage the undertaking of physical, chemical, biological and socio-economic investigations, which are directed to current and emerging issues;

and

2.1.4 promote co-operative federal-provincial endeavours when the objectives are of joint interest

These two statements exemplify the ongoing activities of federal research establishments. Substantial progress has been made in addressing priority issues such as understanding the impacts of acid precipitation on aquatic ecosystems, transport mechanisms of some toxic chemicals in the freshwater environment and the effects of water demand management strategies on industrial and municipal water use. In the socio-economic field, some progress has been made in addressing the effects of water demand management strategies on industrial and municipal water use. Specific achievements on these issues and other priority concerns can be found in Part II, sections 1, 2, 3, 5, 6, 22 and, in particular, section 24.

Many issues are being tackled by the combined research efforts of several government departments at both the federal and provincial level. For example, health and environment departments at the federal level are working with their counterparts in the Atlantic provinces on a study of toxic chemicals in drinking water (see II.6.3).

Several co-operative research projects between DOE, Agriculture Canada and provincial governments are addressing the development of sustainable agricultural practices. (See II.24.2.)

EMR is involved in different types of research in the field of pollution abatement through addressing concerns associated with energy and mineral production. The department is also carrying out research studies in water chemistry and modelling of ground-water movements. (See, II.2.4 and II.24.3.)

Addressing the scientific concerns of CEPA, in particular, gathering evidence on the fate and effects of the forty-four chemicals on the priority substances list (Appendix B), is one of the major new tasks confronting the federal government. This will require co-operative efforts from researchers in all sectors: government, university and industry.

2.1.2 establish research advisory mechanisms with broad representation from scientific and applied research clientele, to advise on program needs and priorities

Communication between scientists and water managers within the federal government has been fostered in recent years through several mechanisms. Within DOE, "Science Forums" have been held on a regular basis and have led to an on-going exchange on priority issues and major scientific achievements between senior managers and scientists. The establishment of Research Advisory Boards is being considered for both DOE's national research institutes, the National Water Research Institute (NWRI) and the National Hydrology Research Institute (NHRI). NHRI's research agenda is currently being guided partially by the Western Research Advisory Committee, which facilitates communication between operational program managers within DOE and scientists at NHRI.

Interdepartmental funding programs, such as the Panel on Energy Research and Development (PERD), managed by Energy Mines and Resources (EMR), and Pestfund, managed by Department of Agriculture (DOA), are other less obvious mechanisms for influencing research priorities. PERD has been particularly successful in combining government and private-sector expertise to address specific priorities such as deep-well disposal of toxic wastes and effects of oil sands and heavy oil operations on northern aquatic ecosystems.

2.1.3 develop and maintain, with the provinces and territories, water data and information systems directed to improving the knowledge available for managing Canada's water resources

The full scope of the federal government's water quality and quantity data and information systems and their applications are provided in II.23. Most of these data networks are developed and maintained in co-operation with provincial governments or, in the case of the territories, with DIAND. Increased emphasis is being placed on developing greater capabilities for the analysis and interpretation of data, as well as on modernization of office and field equipment.

A major proposal has been made for an integrated (quality/quantity) data network in the Mackenzie River basin, but funding remains a barrier to implementation. In general, appropriate resourcing is an impediment to improved monitoring, particularly in remote areas and for substances which are present only at very low levels. Both of DOE's research institutes are investigating remote sensing technologies for water quantity and quality monitoring, which could reduce the demand for resources for field monitoring.

Developing water quality agreements with the provinces and territories will continue to be a short-term priority; six have been signed and two more are expected to be completed by the end of fiscal year 1989-90 (see II.2.1).

Ground-water monitoring is a neglected area of data collection, although some progress has been made, such as DIAND's work to develop and inventory the resource north of 60° and proposed work under DOE/provincial agreements in the Atlantic Region. Research is also providing some information on the extent and quality of ground water, but a concerted ground-water monitoring program, even if limited to areas of concern, will require additional resources (see II.3).

2.1.5 undertake and support research and technological development and transfer efforts

Active government support and participation in water research and technology development are essential to support appropriate regulation development and sound environmental policies and to develop strong partnerships with industry.

Although appropriate water charges may foster technological efficiencies, simply increasing water prices across the country could mean that all Canadians merely pay more for old technology and miss the major opportunity created with infrastructure renewal to develop a viable, leading-edge water technology industry in Canada. It is essential that the government provide leadership for development of cost-effective technologies which support a strong export-creating environmental consulting and engineering industry.

2.1.6 encourage opportunities for non-governmental technology development, and the growth of a private sector water conservation industry

Some of the highlights of co-operative government/industry research that has resulted in significant technological developments are described in II.25. Notable amongst these is the technology developed by DOE's Wastewater Technology Centre to convert sewage sludge into oil which will be commercialized by a jointly owned Canada/Australian company. This technology will be applied to the Halifax harbour cleanup. Many of the technological innovations from government research have been fostered by the recently defunct DSS Unsolicited Proposals Program, which encouraged other federal departments to enter into joint funding of private-sector and university research that was usually of a technological or applied research orientation.

Industry, Science and Technology Canada (ISTC) is fostering technology transfer and development

through its support to the St. Lawrence River Environmental Technology Development Program. The program is designed to assist development of pollution abatement technologies and is being implemented in co-operation with DOE and Centre St. Laurent.

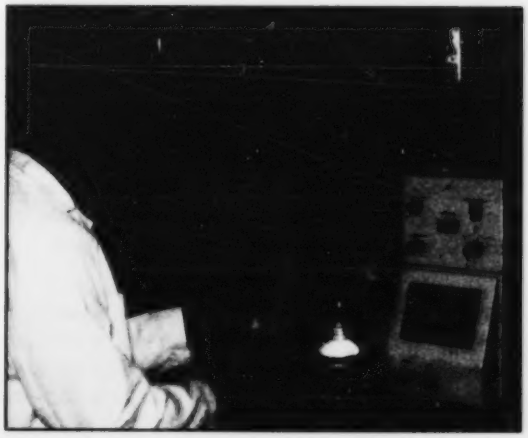
ISTC is also working to strengthen Canadian environmental industries, including those related to water treatment through the Environmental Industries Sector Initiative. This initiative will identify and set priorities among the environmental sciences and technologies that are critical to the competitiveness of Canada's environmental industries demonstrating clear market opportunities and that respond to an urgent environmental need. Initiatives such as NHW's proposed Drinking Water Safety Act may help to promote elements of a Canadian water industry by requiring certification of drinking water technology. The analytical chemistry requirements of CEPA have induced DOE to initiate an independent, self-regulating association of environmental analytical laboratories. The association is expected to improve quality assurance of privately developed analytical data as well as to provide a network for technology transfer.

NWRI has developed a major marketing strategy to promote access by the private sector to its hydraulics laboratory to conduct research and technology development activities. This initiative is geared to a full use of the laboratory's unique equipment, such as the gas transfer flume, recirculating flume and wind-wave flume.

2.1.7 foster international co-operation in scientific and technological research and development and in data information collection systems

International co-operation is a desirable consideration in the context of research. Through participation of both scientists and managers in international conferences and associations (examples of which are provided in II.18), the federal government is able to keep abreast of the latest scientific innovations as well as to market its own expertise. While fiscal restraints have required cautious participation in international activities, most government departments have conducted recent analyses of the benefits of international co-operation and developed appropriate strategies to target international activities effectively.

The growing awareness of the global nature of environmental problems and consequently the need for global solutions have really demanded better international co-operation. This is particularly true of data collection which must be co-ordinated to afford comparison among ecosystems. DOE is an active participant in the development of several global data networks that include water information, such as those of the Global Environmental Monitoring Program on Water (GEMS/WATER) and the International Lake Environment Committee.



2.2 Analysis and Future Direction

The FWP is not very explicit on the roles of the private sector (particularly industry) and universities in water research and development. It is very clear that the federal government cannot alone address all of the water research problems facing Canada. In recent years, there has been a growing trend toward co-operative research efforts between scientists in the federal government and those in the provinces, universities and, most recently, in industry. This has been necessary for a number of reasons. The complexity of water problems requires diverse expertise and significant resource commitments (both human and financial). Often the responsibility for both the problems and, therefore, the solutions rests with many jurisdictions as well as the private sector.

Solutions to many water problems will involve the development of technology that has commercial potential; therefore it is beneficial to involve the

private sector to ensure commercial applications are realized. The promotion of a private-sector water conservation industry is an area where little progress has been made and which will require particular attention over the next few years. As we move to more realistic pricing for water, the demand for such technology will naturally increase, but other steps to promote both the development and application of efficient water technology may be necessary.

As a result of fiscal restraint measures, a number of mechanisms for encouraging co-operative research have been lost. DOE's Water Resource Research Support Program, which was very effective in directing university research and training towards water issues of priority to the department, was cancelled at the end of 1986. The DSS Unsolicited Proposals Program to support innovative research and development primarily in the private sector was cancelled in 1989. No alternative to this program is proposed at this time, but such a program is seen as an important component for development of a strong water technology industry in Canada.

An effort should be made to replace these partnership programs with initiatives that would encourage university and private-sector scientists to take an active and significant role in Canadian water research and development issues. Such initiatives could include a major program for cost-shared water technology demonstration projects between the government and private sectors as a mechanism for promoting transfer of technology developed by government researchers.

The federal government recognizes the need to strengthen its own multidisciplinary research programs (including better integration of natural and social sciences) to address water issues of national and regional significance, working in co-operation with others as far as possible.

The demand for sound data and interpretive expertise is predicted to increase to meet the requirements of sustainable economic decisions and will be a challenge to the federal government. Both sustainable development and state of the environment reporting will require federal leadership and improved integration and analysis of water quality and quantity data. The current lack of sound knowledge and data on ground-water resources should be overcome by a more comprehensive ground-water monitoring program.

It should also be noted that the development of other low-pollution technologies and the adoption of recycling practices can significantly reduce water consumption. The ISTC Critical Science and Technology initiative is looking at process technologies.

Information:
National Water Research Institute (DOE)
(416) 336-4503
National Hydrology Research Institute (DOE)
(306) 975-5751
Freshwater Institute (DFO)
(204) 983-5118

3. INTEGRATED PLANNING

3.1 Progress

The FWP endorsed the need for integrated planning to ensure that the development of water resources recognizes the many values of water (including recreational, social, environmental and heritage values as well as economic) to ensure the continued productivity of water ecosystems. The federal government views integrated planning as an essential strategy for bringing together all interests and jurisdictions within a watershed to co-ordinate their development activities.

The federal government has neither the resources nor the legal responsibility to undertake full-fledged integrated planning on all major watersheds. A challenge lies in co-ordinating cross-sectoral interests, developing water resource management plans of sufficient scope and detail on critical water systems, and adopting decision-making mechanisms that take into account all uses and values of water.

The initiatives and achievements in integrated planning noted below are not intended to be a comprehensive survey, but rather a selection of policies, programs and projects which illustrate some elements of the strategy. They show that the strategy to some extent represents an affirmation of past successes, but also that much remains to be done.

3.1.1 adhere to integrated water resource planning in areas of federal jurisdiction, and in interjurisdictional waters subject to federal-provincial-territorial agreements, in order to ensure that all values are given full consideration

The Department of Fisheries and Oceans (DFO) is promoting integrated resource management approaches in Newfoundland and in the Fraser and Cowichan river watersheds in British Columbia. As well, the Yukon Fisheries Protection Authorization was co-signed by DFO, DIAND, and DOE to provide protection of instream uses while allowing for the placer mining industry to continue to make an important contribution to the Yukon economy.

DIAND, under the authority of the NIWA, has in place a regulatory framework that integrates conservation and protection of water resources with multisector economic development. Integrated resource planning has been initiated for the NWT portion of the Slave River basin by DIAND, the Government of the Northwest Territories (GNWT) and DOE. Results of this study will be integrated with a multiyear water resources study of the Peace-Athabasca-Slave river basins to be conducted by DOE, DIAND, DFO, the Alberta DOE and GNWT. The purpose of the study is to determine the cumulative effects of industrial activities on the ecology of the basins. This broader study will be sponsored under the *Canada Water Act*.

DOE has undertaken the development of a Federal Policy on Wetland Conservation, which focuses on integrating land- and water-use activities so as to sustain the ecological and socio-economic functions of federal wetlands and provides for co-operation with provinces/territories in attaining the goal of "no net loss" of wetlands.

3.1.2 encourage, on the basis of a watershed, or other appropriate spatial unit, the integration of water management plans and objectives with those of other natural resource interests - fisheries, forestry, wildlife, mining, hydro power, and agriculture - to reflect the unity of natural processes and the interdependence of uses and users in that spatial unit

Agriculture Canada, through the PFRA, is broadening its approach to integrated water resource planning in shared federal/provincial jurisdictions. The PFRA works closely with provincial agencies, communities, farmers, and non-governmental organizations (NGO) on the development of projects to provide water for municipal and agricultural uses. Increasingly, other considerations such as water-based recreation and waterfowl and fisheries habitat enhancement have been taken into account. The PFRA is now developing a broad strategy for agricultural water programming which will take into account the questions of soil, water and land use.

Parks Canada, through the CHRS, has encouraged provinces to develop integrated plans for heritage

rivers such as the Mattawa in Ontario, the Bloodvein in Manitoba and the South Nahanni in the Northwest Territories.

DOE is involved in a number of co-operative planning processes with provinces which incorporate principles of integrated planning and which are described in II.7.3.

To facilitate integrated planning on a watershed basis, DOE is working towards better integration of its water data programs in order to maximize the effectiveness of existing networks (see II.23.4).

3.1.3 establish and apply evaluation criteria to all federally sponsored projects to ensure their compatibility with federal goals respecting water management, based on an appreciation of the values of water and related resources

Little progress has been achieved in this area. Although the 1984 Federal Environmental Assessment and Review Process (EARP) Guidelines are in place, these are procedural and do not address specific evaluation criteria. The Rafferty-Alameda court decision, however, has rendered these guidelines a law of general application. It is proposed that the existing guidelines be replaced by a more comprehensive set of assessment criteria called the Canadian Environmental Assessment Act and Regulations. Separate guidelines are also in the process of being developed for various sectors; for example, evaluation of irrigation projects and assessment of interbasin transfers.

3.1.4 ensure that all significant national and international water-related development projects, which are supported or initiated by the federal government or for which federal property is required, are subject to the Federal Environmental Assessment and Review Process, so that potential adverse environmental and socio-economic effects can be identified and, to the extent possible, mitigated

All federal departments acknowledge and support the EARP process. In April 1989, the Federal Court, in its decision on the Rafferty-Alameda Dams Project in Saskatchewan, interpreted the requirement for review under EARP in such a manner as to require a federal reassessment of the project before a licence under the IRIA could be issued. As a result of the court decision, the project was interrupted until an initial environmental evaluation was completed. A new licence was then issued, complete with terms and conditions, and construction activities resumed. The project was further challenged in the courts, and in response to the subsequent ruling of December 28, 1989, DOE requested that an EARP panel be established to conduct a full environmental review. Work on the project has been halted during this process.

3.1.5 ensure the participation or cooperation of all relevant coordinating and regulatory agencies

At the federal/provincial/territorial level, co-operation and information exchange on integrated water resource planning strategies take place through the Water Advisory Committee of the CCME. The committee has undertaken the development of National Water Management Principles, among which integrated resource management is featured.

At the federal level, the newly reconstituted (1988) ICW provides for a co-ordinated approach to the planning and management of water resources subject to federal jurisdiction.

At the international level a co-ordinated and co-operative approach to coping with serious water management concerns is demonstrated in the Framework for Lakewide Management Plans for Critical Pollutants, which was recently given approval in principle by the Canadian and U.S. governments. The parties and jurisdictions involved in the Great Lakes Water Quality Agreement (including the public) are now developing an action plan which will guide the activities of Lakewide Advisory Councils and Working Committees.

The Mackenzie River basin is a striking example of the need for integrated planning. It covers 20 percent of Canada's area, three provinces and two territories, and a number of federal agencies are involved in managing its significant resources. Special consultative mechanisms have been established and include the Mackenzie River Basin Committee (an information exchange forum composed of the provinces and territories sharing the waters of

the Mackenzie River) and a specific bilateral negotiating structure (e.g. NWT-Alberta/NWT-Yukon/NWT-Saskatchewan) mandated with developing transboundary water management agreements.

3.1.6 encourage and support opportunities for public consultation and participation in the integrated planning process

Public consultation and participation is a key component of the integrated planning strategy. Opportunities for public participation are provided in all federal/provincial water management studies and under the EARP process. Provisions are mandatory under legislation such as the *Northern Inland Waters Act*. Financial assistance has been provided in many cases to ensure that the interests of native people are taken into consideration.

A good example of public consultation can be seen in the responses to Canada's commitments under the GLWQA. The federal government has embarked on a major cleanup of twelve severely polluted areas around the Great Lakes and five areas shared with the U.S. These Remedial Action Plans are being developed with extensive public consultations and a special fund to ensure federal remedial actions are carried out.

PFRA strongly supports the concept of public consultation and participation. The use of local organizations is a key element in a number of program areas. Through technical meetings and public meetings, the public provides valuable input into environmental reviews and land-use and irrigation planning development.

3.2 Analysis and Future Direction

When the FWP was developed, the focus of integrated planning was co-ordination of water and water-related uses, primarily at the watershed scale. Since that time, the Brundtland Commission has heightened our awareness of the need to better integrate environmental considerations with economic decisions on a much broader scale. While the watershed is still an appropriate level for assessment and planning of many development activities, it is now clear that integrated planning concepts must be applied to decision making on a number of levels.

In recent years, issues such as acid rain have shown us how broad policies, for example, those relating to coal or other energy sources, may affect water beyond its direct use. It has long been recognized that land-use activities such as farming and timber harvesting may affect both the quantity and quality of water. Thus integrated planning concepts must be applied both at the broad policy level as well as at a very specific level of decision making.

It is not possible, however, to undertake major integrated planning exercises for all policies or actions that may have an effect on water. What must be done, however, is to ensure at least that the information and tools used in integrated planning are widely available and applied when major decisions are made. Decisions must be formulated from an ecosystem perspective to identify and address the full implications of development activities. In this sense, the other four strategies of the FWP serve to promote integrated decision making. Broadening our use of economic instruments will help to integrate a wide range of economic decisions with water conservation. Much of our research and data collection is aimed at enabling us to assess or predict the impacts of development on water, which provides us with the knowledge base for integrated decision making. The objective of updating the water legislative base is to promote anticipatory and preventive actions, which will rely on our ability to achieve integrated decision making. A major thrust of our communications efforts is to promote awareness among individuals of the impacts of their everyday actions and decisions on water.

In the future, greater use must be made of co-ordinating mechanisms such as ICW, which, as noted in I.3.5 above, has been reconstituted. The ICW has the potential to serve as a focal point for integrated decision making at the federal level for policies and programs that may affect water.

Equally important to integrated decision making is the continuation of the dialogue and consensus building in sustainable development that has occurred through the National Task Force on Environment and Economy and that is being continued through the national and provincial Round Table processes. The Task Force has clearly pointed out that it is not only the resource sectors that should be integrated, but also economic and fiscal policy.

The new federal Cabinet Committee on the Environment, together with the Round Tables, is proving to be a useful mechanism to assist in the identification and resolution of potential conflicts or inconsistencies in policies and management practices across sectors. The federal government will continue to encourage the development and activities of the national and provincial Round Tables.

In its own activities, the federal government will strive, through broad application of integrated decision making, to promote an ecosystem approach to water management.

Information:
Water Planning and Management Branch
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(819) 997-2071

4. LEGISLATION

4.1 Progress

When the FWP was tabled in the House of Commons, it was recognized that an integral step in support of successful and timely implementation was the "modernization" of federal water legislation and the streamlining of the regulatory process for managing water quantity and quality. The "react and cure" approach was to be replaced by "anticipatory and preventative" actions based on comprehensive and realistic legislation.

To this end, federal departments, including DOE, NHW, DOT and DIAND, have progressed in defining the nature of required legislative change and have developed, or are developing, appropriate instruments to bolster public expectations in regard to successfully dealing with the myriad of water concerns raised by Canadians during the extensive nationwide Inquiry into Federal Water Policy (conducted on behalf of the DOE minister in 1984-85) and during other national investigations (e.g. the 1987 National Task Force on Environment and Economy).

4.1.1 produce legislative provisions to address interjurisdictional water issues relating to levels, flows and quality

DOE conducted a review of its water legislation in 1987-88, with emphasis on the CWA. This review concluded with recommendations, among others, for legislative provisions to address water quality and quantity issues at boundaries between jurisdictions (see I.4.1.4). In addition, the Canada Water Preservation Act (Bill C-156) was introduced into the House of Commons in August 1988. While the proposed bill would have forbidden major water export outside of Canada, it would have provided a licensing regime for small-scale water export. However, parliament prorogued before its passage.

4.1.2 control and manage toxic chemicals throughout their life cycle - from production to disposal

CEPA was passed in June 1988. It controls and manages toxic chemicals throughout their life cycle. Currently, the Act is addressing forty-four priority substances which have been identified as having the greatest potential for harm to human or environmental health. The Act is administered by NHW and DOE (see II.1).

4.1.3 establish water quality standards and guidelines to better protect human health and the diversity of species and ecosystems

CEPA, Part I, enables the Minister of the Environment to formulate objectives, guidelines and codes of practice. Water quality expertise in DOE is being applied to the assessment of various substances to ensure that any releases into the environment are non-threatening. Water quality guidelines will be refined to effectively protect human health and the health of ecosystems.

Canadian Water Quality Guidelines are being developed by DOE in consultation with many federal departments, particularly NHW, and with the provinces through the CCME. To date, objectives have been developed for over fifty organic chemicals including pesticides, thirty-five inorganic and five radiological chemicals. Guidelines for PCBs in sediment have also been developed and are now being reviewed by CCME. Also awaiting CCME consideration is a proposed national protocol for developing sediment quality guidelines (see II.2.2).

NHW is prepared to introduce legislation for a Canada Drinking Water Safety Act. The Speech from the Throne which opened Parliament in 1989 included a commitment to introduce such water quality legislation. The fourth edition of the Guidelines for Canadian Drinking Water Quality were released in early 1990.

4.1.4 **encourage existing mechanisms like the Prairie Provinces Water Board and develop others to address potential provincial-territorial and interprovincial water conflicts**

DOE's legislative review (see I.4.1.1) recommended the writing of legislative provisions to address inter-jurisdictional conflicts concerning water in Canada. Work on these legislative provisions is expected to proceed within the context of the development of comprehensive water and/or environmental legislation in the near future.

4.1.5 **ensure the effectiveness of regulatory measures through the provision of appropriate enforcement and compliance measures**

Regulatory measures are being developed for CEPA. Compliance measures for the Act could include jail terms and fines for those found contravening the regulating requirements.

The federal government is in the process of developing or amending other legislation in support of the commitment to federal leadership in Canadian and global water environmental management. For example, the Minister of DIAND received Cabinet approval in August 1988 to amend the NIWA. The amended Act will be more in tune with the North's evolving political and economic climate and will better respond to the needs of water users and the protection of the northern water resource (see II.14).

Proposed amendments to the NWPA will ensure a more realistic approval process for works constructed in navigable waters and will provide more effective enforcement and compliance measures. Draft compliance and enforcement policies for Sections 35 and 36 of the FA have been prepared.

4.2 **Analysis and Future Direction**

The federal government remains committed to strengthening and updating the water legislative base. Since the inception of the FWP, it has become evident that renewed legislation should give clear recognition to sustainable development and an ecosystem approach to water management, considering the broader environmental context. It should incorporate the concepts of integrated decision making as discussed under Strategy 3. The legislation must also endorse the FWP's principles of beneficiary/polluter pays and recognition of the value of water.

The proposed Canada Water Preservation Act (Bill C-156) would have prohibited major water exports (above 1 m^3/s or 20,000 dam^3) and would have provided a licensing scheme for small-scale exports in fulfillment of the FWP commitments outlined in II.8. The free trade debate in 1988 made it clear that Canadians generally support this policy. Any legislative renewal will incorporate the provisions of Bill C-156.

Information:
Program Analysis and Coordination Branch
Inland Waters Directorate
Environment Canada
(819) 953-1506

5. PUBLIC AWARENESS

5.1 Progress

The shift to sustainable development as the cornerstone for ensuring a lasting environment has prompted a re-evaluation of all communications strategies, including that proposed for water. It is well recognized that sustainable development will only become a reality if Canadians truly become involved in the necessary wide-ranging discussions and active in implementing solutions. More than ever before, Canadians are demanding that government provide comprehensive information about the environment and take decisive action.

5.1.1 ensure that the public is consulted and that its views are considered in all major federal water management decisions

Strong public concerns guided the introduction of CEPA by the Minister of the Environment. CEPA was the product of recommendations made at numerous public meetings and parliamentary hearings. The Act invites a strong public role by providing opportunities for the public to receive information, to participate directly in boards of review and advisory committees, and to comment on regulatory proposals.

Public views continue to be heard in the administration of other federal programs and matters relating to federal jurisdiction. The national FDR program, for example, includes provision for public meetings in communities for which maps of flood-risk areas have been prepared before those areas are finalized in the official designation process. Approximately thirty community meetings were held in the year before flood plain maps were finalized.

As a result of the Federal Court of Canada ruling in April 1989 on the Rafferty-Alameda Dams Project under construction by the Saskatchewan government, the DOE Minister immediately provided for public consultations to guide DOE's recommendations. Subsequently, as a result of a second Federal Court ruling, an independent panel was appointed in January 1990 to conduct a full environmental review which will include public hearings.

5.1.2 encourage public participation and initiate, develop and deliver a national water conservation awareness program

DOE has analysed public opinion, consulted experts and tested the receptivity of over 100 potential partners, such as non-governmental organizations and provincial governments, on the concept of a national water awareness program. There is strong support for a program which would change public perception of water, give greater attention to increasing public understanding of solutions, build partnerships and encourage action. A number of potential challenges have been identified and approaches for such a program proposed. Program funding, however, has not been forthcoming to date.

5.1.3 encourage the efforts of provinces and non-governmental organizations in public information and awareness

The forum for federal/provincial discussions on public information and awareness activities has been the CCME and its WAC.

In DOE, the effectiveness of building partnerships in broadening the base for public dialogue and communication on water is being tested through pilot project partnerships with, for example, the National Survival Institute (NSI), the Canadian Wildlife Federation, the CWWA, the Alberta Access Network, and a production consortium that will engage the corporate sector in a significant water education initiative. A co-operative DOE/Girl Guides of

Canada national program, "Water for Tomorrow," is designed to educate Girl Guides and the public about the importance of water. In 1989, an overview of the status of water education in Canadian schools was prepared under contract with the NSI, and recommendations for the future role of federal assistance were outlined.

The Canadian Wildlife Service (CWS) has developed communication programs in co-operation with a number of non-governmental organizations (NGO) and private-sector partners to encourage wetland preservation. For example, CWS, with private-sector partners, has published a comprehensive study, "Wetlands of Canada," which is both a reference work on the ecology and a status report on our wetlands. CWS is also encouraging public participation in the conservation of wetlands through exhibits at conferences and public events.

DFO is encouraging public interest groups and the private sector to conserve, restore and develop fish habitats through communications materials such as pamphlets, slide shows, videos and a Fish Habitat Improvement Guide. Aquatic debris is an area in which provinces and non-governmental organizations can play a major role. DFO is currently working with Pitch-In Canada to support development of a national beach cleanup campaign and with the Environment and Plastics Institute of Canada (EPIC) on its anti-litter campaign. Co-operation with other groups will be pursued as opportunities permit.

The federal government recognizes that water has a special value as a sustaining force for traditional lifestyles of Canada's native people and continues, through DIAND, to encourage greater native participation in water allocation and management decisions involving instream and traditional water uses.

5.1.4 ensure public access to information on the extent and health of water resources through appropriate means, including a State of the Environment reporting system

The public has a genuine need for basic information on today's water issues and perceptions. This information is being assembled and distributed by DOE, DFO, NHW and others in a number of forms including videos, fact sheets and displays. DOE has a major public information program during Environment Week and regularly uses its displays at other public events. A chapter on water resources will be included in the federal State of the Environment report to be published in 1991. DOE has started work on a Canada Water Book on the state of the water resource.

5.2 Analysis and Future Direction

This strategy was developed primarily to ensure that individual Canadians are sufficiently aware of the value and importance of water to enable them to participate in the long-term protection and management of Canada's water resources. Since the FWP was developed, it has become evident that communications efforts must be targeted to a number of audiences: individual Canadians (particularly youths), decision makers in industry and water management, all federal departments and non-governmental organizations. This will require diverse strategies and new co-operative partnerships to deliver the information effectively.

The level of communication about water is generally increasing to meet the growing public demand for information. To the extent that future communications will have to lead to specific solutions, the interest and commitment of key departments is going to be more important than ever before. Therefore, there is every reason to encourage the present trend in all departments of developing the inherent communications potential in staff and programs, even with resource limitations.

The efforts of individual departments, valuable as they are, cannot realize the same potential as a more co-ordinated effort. Many of the issues of greatest public concern, such as safe drinking water, cross departmental responsibilities and expertise. DOE has started a concerted effort of consultation and co-ordination with other key departments and within DOE. Program managers are beginning to realize the value of water as a common theme for a broad range of environmental programs and as a practical way of demonstrating sustainable development in action. But the essential task set out by the FWP, that of changing public attitudes toward the value of water, will require a major federal push with new resources.

With increasing public demand for solutions, which themselves depend on a fundamental change in attitudes, the urgency for improved communication and education grows steadily. The present efforts are not up to this challenge. An intensive communications effort is needed nationally for a three- to five-year period, with the federal government acting as the catalyst for a broad national dialogue directed at changing the attitudes and behaviour underlying our current water problems. The foundations now being laid for co-ordinated federal leadership would allow for such a program.

Information:
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PART II: SPECIFIC POLICY STATEMENTS

The purpose of the specific policy statements, as they appear in the FWP, is to demonstrate the application of the policy strategies in relation to selected areas of federal concerns. This part takes a structure similar to the one presented in the FWP, and a progress report is submitted under each commitment. Furthermore, as each policy statement is introduced, a brief analysis on the status of the concern is also offered, when applicable.

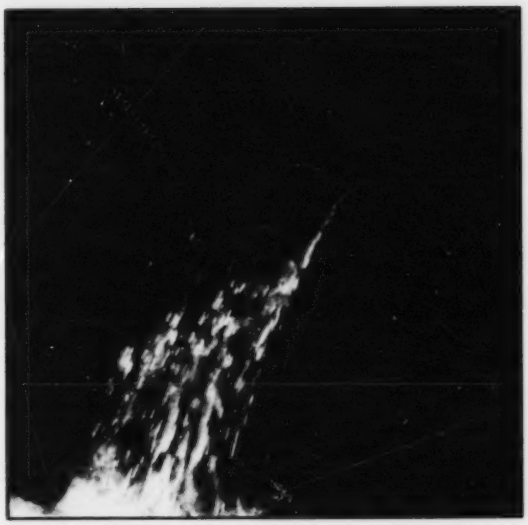
1. MANAGEMENT OF TOXIC CHEMICALS

One of the most pressing issues facing Canadians today is the impact of toxic chemicals on human health and the environment. It is estimated that there are up to 100,000 chemicals in commercial use worldwide, and about 1000 new ones entering the market every year.

The FWP identified four areas where action could be taken to reduce the risks of contamination: life-cycle management of chemicals, preparation of environmental principles for federal agencies, development of national environmental quality objectives, and enforcement. Through the June 1988 promulgation of the *Canadian Environmental Protection Act* (CEPA), the federal government has responded to each of those points.

1.1 controls so that the life cycle of chemicals is properly managed

CEPA takes a comprehensive management approach to toxic substances. It provides the legislative basis to impose controls at each stage of a substance's life cycle. It adopts a two-pronged approach to prevent toxic contamination: tackling those substances now in the Canadian marketplace and controlling the introduction of substances new to Canada. CEPA creates a list of existing substances whose impacts need to be assessed on an urgent basis. The first Priority Substances List was announced February 11, 1989 (Appendix B). Joint DOE/NHW work has begun on health and environmental hazard assessments of each of the forty-four substances on the list. These assessments will provide the basis for necessary control actions. Prior to the introduction of new substances in Canada, CEPA requires importers and manufacturers to submit data on which the government will base its assessment if the particular substance is necessary. An assessment will determine whether the substance can be allowed into the country and, if so, the need for controls. This requirement will be in place in 1990, following the completion of an inventory of substances already in Canadian commerce.



Under the authority of the *Pest Control Products Act* (PCPA), DOA regulates pesticides by ensuring the safety, merit and value (including purity, potency, efficacy and labelling integrity) of pesticides offered for sale in Canada. This includes minimizing the risk to human health and to the environment and the establishment of guidelines (e.g. for pesticide research and for pesticide registration data requirements) in consultation with federal advisors, provinces,industry and the public.

Under the authority of the *Fertilizers Act*, DOA ensures that fertilizers, fertilizer-pesticides and supplements manufactured, sold or imported into Canada are safe and pure (free of substances harmful to crops, animals and humans), potent (contain necessary nutrients), efficacious and labelled to avoid fraud.

1.2 **guidelines and objectives for federal departments, agencies, Crown corporations and regulatory bodies to ensure efficient and effective delivery of environmental protection programs**

All federal agencies are required to respect regulations developed under CEPA in their day-to-day operations. In addition, CEPA authorizes the development of guidelines and regulations specific to federal departments, agencies, and Crown corporations and to their works, undertakings and lands.

The Safety, Health and Security Division of EMR issued departmental policies and procedures on the management of dangerous substances in February 1988. In EMR's Canada Centre for Mineral and Energy Technology (CANMET), efforts are being made to sensitize staff to limit the quantity of chemicals being purchased. A network of hazardous waste co-ordinators within CANMET has been set up to manage the disposal of waste products such as chemicals.

DOE has undertaken discussions with various federal departments to address the implementation and enforcement of CEPA and its regulations; specifically the application of Part IV (federal undertakings and lands) of the Act.

1.3 **national environmental quality objectives and guidelines in co-operation with provinces, territories, industry and other sectors representative of Canadian society**

The Priority Substances List established under CEPA (Appendix B) identifies a working agenda for DOE and NHW insofar as substances for which environmental quality guidelines and objectives are likely to be required. The guidelines will provide the basis for the assessment of individual substances, for monitoring and for developing regulatory controls.

1.4 **enforcement and compliance measures in relation to the Canadian Environmental Protection Act**

Enforcement is a vital aspect of the CEPA. Violators are warned, issued tickets, prosecuted and/or required to reimburse any financial benefits received as a result of committing an offence. The Act includes significant penalties ranging from fines of $200,000 and six months in jail to $1 million and five years. For criminal offences, life imprisonment is possible. DOE has established investigative units in each of its regional offices to follow up on pollution problems and suspected violations.

Information:
Environmental Protection
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2. WATER QUALITY MANAGEMENT

The direct costs associated with pollution cleanup are high, and increasing concern is being expressed over the long-term health risks associated with water of inferior quality. The message, therefore, is prevention – and prevention is accomplished through a combination of knowledgeable decision making (science leadership), economic incentives (polluter/beneficiary pays) and public awareness.

Recent initiatives such as the promulgation of the CEPA and the development of Canadian Water Quality Guidelines under the auspices of the CCME are major steps towards a realistic approach to water quality management.

2.1 develop and apply, in co-operation with the provincial governments, appropriate strategies for identifying the nature and extent of the impairment of water quality

DOE, in collaboration with the provinces and territories and with DIAND's co-operation north of 60°, has made significant progress in monitoring and assessing the quality of water in rivers and lakes throughout Canada by establishing formal federal/provincial agreements. These agreements define the responsibilities in collecting and analysing water quality data in the provinces and territories. Unlike the water quantity data collection arrangements, where the federal government collects all of the data (except in Quebec), the water quality agreements allow both governments to share in the work. DOE provides the essential interlaboratory quality assurance through NWRI at the Canada Centre for Inland Waters (CCIW) in Burlington.

Agreements have been signed by DOE with British Columbia, Manitoba, Quebec, New Brunswick, Newfoundland and PEI. Negotiations with the remaining provinces are in progress and arrangements are expected to be concluded with Saskatchewan and Nova Scotia by March 1990. Policy changes in Alberta have previously prevented the signing of a negotiated agreement. Efforts are now under way to resolve this. Negotiations with Ontario continue at a slow pace. The province, already having an extensive water quality

network in place, does not perceive a federal/provincial agreement to be a priority at this time. DIAND and DOE have concluded negotiations with the Yukon and NWT. They will be signed when resources have been allocated for their implementation.

Contamination of ground water by pesticides is a concern. Although the problem has achieved high visibility and considerable legislative and policy action in other countries, including the United States, the extent and nature of ground-water contamination in Canada has received less attention and is less well documented.

In 1987, the Pesticides Directorate of DOA initiated a strategy to deal with this concern. A report was released in January 1989 that contained information on the leaching potential of pesticides and areas vulnerable to ground-water contamination across Canada. The next phase of the strategy will include the development of co-operative monitoring/research programs with Environment Canada and the provinces.

Aquatic debris, particularly plastic debris, has become a cause of increasing public concern. This debris comes from a number of sources, among which are ships (commercial and recreational), fishermen (in the form of lost and abandoned gear), beachgoers and stormwater overflows. The debris adversely affects aquatic life, impairs the operating efficiency of vessels and reduces aesthetic values. A DFO-led interdepartmental task force addressed the issue in 1988-89, noting the need for more information on the extent of the problem in fresh water,

with particular emphasis on the Great Lakes and the St. Lawrence River. The need for a program to raise public awareness and to promote individual action was also identified.

NHW is paying particular attention to the effects of pesticides and other organic contaminants on drinking water supplies as noted in the fourth edition of the Guidelines for Canadian Drinking Water, which was completed in early 1990. That edition shows an increase in guidelines from fourteen to forty-one for pesticides and from three to fourteen for other organic compounds.

DIAND has implemented a program to address the problem of contaminants in northern ecosystems and native diets from both a national and international perspective. Activities in support of this program resulted in a benchmark report on contaminants in the North (June 1989), an international conference in Oslo with DIAND as co-host (September 1989), workshops and inter-agency committees and the redesign of the Canadian research and monitoring program (June 1989).

2.2 develop, with provincial governments, Canadian Water Quality Guidelines that are relevant to Canadian environmental conditions and encourage a uniform approach to establishing water quality objectives across Canada for the preservation of water quality

Canadian Water Quality Guidelines are being developed by DOE in consultation with many federal departments, particularly NHW, and with the provinces through the CCME. So far, guidelines have been released for over fifty organic chemicals, including pesticides, thirty-five inorganic and five radiological chemicals. Guidelines for PCBs in sediment have also been developed and are now before CCME, as is a proposed national protocol for developing sediment quality guidelines.

Canadian Recreational Water Quality Guidelines, an NHW project involving the participation of DOE and eight of the provincial governments, has been updated.

To encourage a uniform approach to setting water quality objectives (based on the above guidelines), CCME has held provincial workshops in British Columbia, Alberta, Manitoba and Nova Scotia. A national workshop was held in Halifax in September 1989.

2.3 undertake, encourage and support measures to protect water quality *(see also Part II, sections 1, 2.1, 2.2, 2.4, 3 and 6)*

To report progress in implementing this policy element, as in many other areas throughout this report, would be to comment on the myriad of day-to-day operational and research activities undertaken by many federal departments in support of resource management. Programs in DOE, NHW, DFO, DIAND, EMR, DOA and other departments contribute in a significant way to the federal water management effort (see, for example, Part II, sections 1, 3, 6 and 9).

For example:

DOE continues its water quality monitoring and surveillance program across Canada and maintains the chemical and bacteriological data base NAQUADAT. Major ions, nutrients, trace metals and organic contaminants are some of the key categories for classifying over 1400 variables from 8500 sampling locations. More than 50 papers and interpretive reports were published in 1987 and 1988 – in addition to the many research reports released by DOE's two national research institutes in Burlington and Saskatoon. These reports discuss a variety of water quality issues, e.g. long-range transport of air pollution; toxic chemical pollution; pollution in the St. Lawrence, Niagara and Fraser rivers; nutrients in western Canada; and pesticides in the Atlantic region and the Prairies.

To increase the effectiveness of its national monitoring program through the mechanism of water quality monitoring agreements with the provinces (see II.2.1), DOE has been designing a national reference network, taking into account current and foreseeable issues such as the effects of toxic chemicals and of human activities (e.g. agriculture, industry and urban development) on the aquatic environment.

DOE has been developing methods to detect and measure new substances of environmental concern such as metolachlor, chloropropanes and bromoxy-

nil (applicable to II.23.6). Also through automation and improved analytical technology, it has achieved significantly higher productivity for such costly analysis as dioxins and furans in water, sediment and fish tissues. This is enabling DOE to better respond to the increased demand for environmental data with the same level of resources. To assure data reliability and the measurement of variables at appropriate detection limits, DOE's National Water Quality Laboratory has recently implemented a highly successful internal quality assurance program.

Increased emphasis has been placed on informing Canadians about the state of the water environment. In support of the FWP's water awareness strategy, a water quality communications plan is now being developed.

EMR reports that, as of 1988, 170,000 sites covering an area of 2 million square kilometres have been sampled for stream and lake sediment data under the National Geochemical Reconnaissance Program. A paper on applications of regional geochemical drainage surveys to environmental and public health concerns has been prepared.

2.4 undertake, encourage and support water quality management through research and development *(see also Part II, sections 2.3, 2.4, 2.5 and 24)*

The FWP recognizes science leadership as a prerequisite to sound resource management. Several federal departments, the provinces, universities and the private sector are involved in research which has implications for national water quality management; however, most research directly in support of water management is undertaken at DOE's two national research institutes, NWRI and NHRI (see II.24.3).

In June 1988, the federal government announced a $110-million, five-year plan to conserve and restore the St. Lawrence River. Of this, $55 million has been allocated to the development and application of environmental technologies through the establishment of the Centre St. Laurent in the Montreal area.

CWS conducts research into wildlife as indicators of environmental quality. For example, eggs and/or prey of birds such as the Great Blue Heron in British Columbia and the Herring Gull in Ontario are studied to determine the effects of dioxins, furans and similar toxic chemicals. CWS also conducts research in the contamination levels of water used by wildlife.

EMR with its main research and technology development arm, the Canada Centre for Mineral and Energy Technology (CANMET), is demonstrating its commitment to water quality by addressing concerns associated with energy and mineral production. EMR's Energy Research Laboratories (CANMET/ERL) are researching the treatment of wastewater from oil fields. In co-operation with others, CANMET is involved in the treatment of tailings, pond sludges and effluent water from heavy oil production processes, as well as the safe disposal of solid wastes produced by fluidized-bed combustions and limestone inspection technology. The use of cyanide in gold production and the abandonment of mine wastes are prompting CANMET to develop the technology to control potential water pollution from the mining and processing of minerals. A program called the Mine Environmental Neutral Drainage Program (MEND) is a tripartite research program dedicated to the development of technology that can be used to decommission acid-generating tailing and waste rock sites. Industry, the federal government, and the provinces of British Columbia, Manitoba, Ontario, Quebec and New Brunswick are participants in the program. Within the $12.5 million program are research components dealing with methods to treat acidic seepage, prediction, prevention, control and monitoring. About $1.5 million has been dedicated to developing new and improved treatment technology for acidic discharges and sludges. One of these technologies is the passive treatment of seepage using wetland ecology and microbiology. It is anticipated that these wetland systems will be self-supporting for hundreds of years.

EMR's coal research laboratories are co-operating with industry and environmental agencies to develop and transfer chemical and physical unit processes for the improved treatment of bitumen/oil emulsions, effluent waters and tailings. The laboratories are also involved in the development and demonstration of technology which will improve the economics of coal recovery and processing while meeting environmental standards and resulting in clean or upgraded coal products. CANMET's mining research laboratories work in the field of tailings and mine waste disposal.

DFO carries out a number of water quality programs from its laboratories in Winnipeg (Freshwater Institute) and Burlington (Great Lakes Laboratory for Fisheries and Aquatic Sciences). Small lake studies are conducted in order to assess the impact of chemicals, such as cadmium, and some organic contaminants on lake ecosystems. Monitoring studies of primary and secondary production and community dynamics are also being conducted in Lake Ontario.

DFO is a major participant in the implementation of Remedial Action Plans, with recent emphasis placed on Hamilton Harbour and Bay of Quinte. Monitoring studies for dioxins and furans have been carried out in the vicinity of pulp and paper plants, and studies on the impact of pesticides have been carried out in support of DFO's role in pesticide registration. The department is also a major contributor to federal water quality objectives.

2.5 seek to ensure that international and interprovincial water quality requirements are met *(see also Part II, sections 2.1, 16 and 17)*

New water legislation being considered by DOE will incorporate provisions to better articulate the federal mandate for international and interprovincial water quality management.

DOE's regional offices continue to monitor and assess surface- and ground-water quality at international and interprovincial boundaries (see II.2.1).

Support continues to be provided to the IJC water pollution advisory boards for the St. Croix, Red and Rainy rivers. The joint efforts of DOE, New Brunswick DOE, the State of Maine and the U.S. EPA have resulted in the restoration of a 14-km polluted stretch of the St. Croix River. Since 1980, fish have been returning in large numbers.

The Canada-U.S. Water Quality Committee on the St. John River, a co-operative venture involving five jurisdictions, has been addressing water quality problems since 1972. Many improvements to wastewater treatment systems in both Canada and the U.S. have been reported. Current activity centres on the apportionment of assimilative capacity between Canada and the U.S.

Under a Canada/Ontario agreement, DOE and Ontario have been developing strategies and implementing programs for Canada to meet its obligations under the Canada-U.S. Great Lakes Water Quality Agreement. Major initiatives include the Remedial Action Plans and Lakewide Management Plans already mentioned under I.3.1.5. Biennial reporting on progress in implementing the GLWQA is a requirement under the 1987 Protocol and will ensure, together with the Canadian responses to the IJC biennial reports, that the IJC is fully aware of GLWQA implementation status. The response to the IJC's fourth biennial report is expected to be submitted in April 1990.

DOE and Ontario have been working effectively with their U.S. federal and state counterparts in implementing the Niagara River Toxics Management Plan. A major accomplishment has been a four-party-approved ambient monitoring program that has been undertaken by DOE's Ontario Region.

Studies continue into the effects of acid rain on the lakes, rivers and wetlands of Atlantic Canada. Studies in 1989-90 will include Labrador lakes with a cursory look at toxic contaminants in rain. Agencies involved will include DOE, DFO, provincial environment departments and universities.

In 1988, experts from around the world attended a symposium in Wolfville on the long-range transport of airborne pollutants. The results will influence future DOE activities in addressing this major concern.

In the west, the Prairie Provinces Water Board (PPWB) continues its monitoring of interprovincial waters in accordance with its Water Quality Plan. All unusual water quality conditions are reported to the PPWB within 24 hours of detection.

Information:
Water Quality Branch
Inland Waters Directorate
Environment Canada
(819) 997-1920

3. GROUND-WATER CONTAMINATION

Pesticides in Canada's ground water, leaking chemical dumps and underground storage tanks, and contamination from subsurface waste disposal and toxic chemical spills are only some indicators of the extent of the ground-water contamination problem. Those matters deserve immediate attention. The federal government is committed to the preservation and enhancement of the ground-water resource, but is hampered by a serious shortage of ground-water expertise. Nevertheless, significant progress is being made.

Over the last six months, DOE has been developing a strategy for putting into effect the five policy elements of the Groundwater Contamination Policy. Preliminary discussions have taken place between DOE and EMR and Agriculture Canada, with the university community and the private sector, and informally with provincial officials. As a consequence of these discussions and others within DOE, it has become evident that ground-water contamination, as an issue, cannot be dealt with separately from the overall concern with ground-water management.

It is also becoming clear that co-operation, not only between, but within, the various levels of government, is essential if effective management action is to be taken to deal with the problem of ground-water contamination.

Accordingly, DOE plans to develop a draft departmental strategy and then to consult with all other federal departments to develop a federal ground-water strategy. The ICW will probably be the forum used to develop this federal consensus.

At the same time, initiatives will be pursued with the provinces to establish and reinforce the joint federal/provincial approach to ground-water management.

3.1 develop, with provincial governments and other interested parties, appropriate strategies, national guidelines and activities for ground water assessment and protection *(see also Part II, sections 2.1 and 6.2)*

DOE, with the co-operation of other federal departments, notably EMR and DOA, continued to improve the data base required to support federal ground-water management interests. Activities included the preparation of data reports on regional and national ground-water contamination, joint projects with various provinces and territories mainly associated with pesticides and specific applied research studies intended to provide background information for the eventual development of guidelines for deep-well disposal and for the prevention of well contamination.

At the request of Alberta, DOE hosted a Federal/Provincial Workshop on Groundwater Data Banks on February 6 and 7, 1990. Six provinces and both territories were represented, and a number of issues of joint federal/provincial concern were identified. Specific actions to be taken will be discussed at a follow-up workshop to be held in the fall.

3.2 conduct research and undertake technological development and demonstration projects in response to ground water problems *(see also Part II, sections 24 and 25)*

DOE's research, development and demonstration projects carried out in response to ground-water problems have continued at pre-1987 or somewhat lower levels except for some specific problems (e.g. Ville Mercier). Major ground-water contamination problems addressed include pesticide contamination of ground water (western Canada, Maritimes), hazardous waste sites (Ontario, Quebec) and deep-well disposal (Alberta, Saskatchewan, Ontario). Other concerns addressed include acid mine drainage (British Columbia), landfills (national), fluidized bed combustion wastes (New Brunswick), ground water and LRTAP (Ontario) and nuclear fuel cycle (Saskatchewan, Ontario).

NHW is embarking on a number of ground-water studies, including some with EMR which will examine the distribution of inorganic contaminants as a function of geological characteristics.

GSC of EMR has developed equipment for multilevel monitoring of ground-water systems and emplacement of ground-water sampling and piezometer equipment. This equipment has been transferred through patents and licensing to industry.

3.3 develop exemplary ground-water management practices involving federal lands, responsibilities, facilities, and federally funded projects

Existing ground-water management practices focus on the environmental assessment of proposed developments (mines, pipelines and impoundments, etc.) and the investigation of adverse impacts of existing ground-water contamination (chemical waste disposal sites, spills, etc.). A preliminary feasibility study of ground-water assessment at federal facilities was conducted in the Atlantic Region.

3.4 develop measures to achieve appropriate ground-water quality in transboundary waters

International transboundary water quality related to ground water has been monitored and maintained at acceptable levels under transboundary agreements for the Poplar River, the Niagara region, the Flathead River, the Saint John River valley area of New Brunswick and Sarnia, Ontario. Interprovincial ground-water quality concerns are kept under review by agencies such as the PPWB Committee on Groundwater under arrangements which appear to be effective in maintaining ground-water quality. Plans for establishing networks for monitoring ground water as it relates to the long-range transport of airborne pollutants have been developed and await resources for implementation.

3.5 provide information and advice on ground-water issues of federal and national interest

Perhaps the greatest contribution to the issue of ground-water contamination has been the provision of information and advice to a large number of provinces, consulting firms and private citizens. Topics of interest included the health effects of ground-water contamination, including contamination by a number of pesticides, benzene, gasoline and trichloroethylene, the treatment of hydrocarbon-contaminated municipal supplies, pesticide contamination, deep-well disposal, environmental assessments and ground-water remediation. Other activities included a national report on ground-water contamination and a report on the effects on ground water of the long-range transport of airborne pollutants.

DOE and EMR, in collaboration with provincial governments and agencies and the petroleum industry, sponsored a conference on Prevention and Treatment of Groundwater and Soil Contamination in Petroleum Exploration and Production. A conference for the downstream petroleum industry on the same subject will be held in the fall of 1990.

Information:
Groundwater Section
National Water Research Institute
Environment Canada
(416) 336-4587

4. FISH HABITAT MANAGEMENT

Fish habitats – rivers, streams and lakes – form the foundation of Canada's fisheries, and it is important that they be preserved from degradation and restored to their earlier potential where significant benefits can be expected. Direct discharges of industrial, municipal and agricultural effluents, physical changes resulting from land-use activity, instream construction, and acid rain and airborne pollutants can all threaten fish habitats. Through the Fish Habitat Management Policy, the federal government is committed to achieving a net gain of productive fish habitat. In support of this goal, the federal government is committed to three management strategies – conservation, restoration and development.

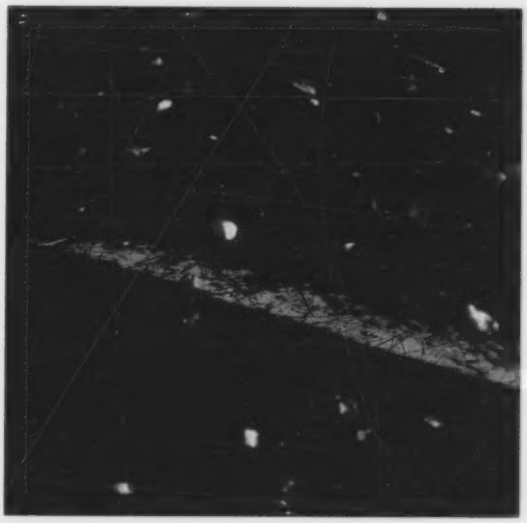
4.1 develop national guidelines for the achievement of no net loss through incorporating fish habitat requirements into land and water use projects that could affect fish habitat

Draft guidelines for implementing the "no net loss" principle and draft compliance and enforcement policies for Sections 35 and 36 of the *Fisheries Act* have been produced. DFO has played a major role in developing the integrated guideline approach to resolving forestry and fisheries conflicts in British Columbia.

4.2 participate in and encourage integrated resources planning that will allow for the incorporation of fish habitat conservation measures early in the planning process

DFO and the Canadian Environmental Assessment Research Council have explored integrated resource management approaches in Newfoundland. Work has also been initiated for the Fraser and Cowichan river watershed in British Columbia. A memorandum of understanding with the North Fraser Harbour Commission was developed to create a habitat compensation bank for the north arm of the Fraser River. A DFO/Caribou Mines Habitat Compensation Agreement has resulted in the construction of a lake to replace lost habitat.

Habitat concerns are an integral component of the Yukon Fisheries Protection Authorization, which was co-signed by DFO, DIAND and DOE. This policy provides for fisheries and environmental protection of Yukon rivers, while allowing the placer mining industry to continue to make an important contribution to the Yukon economy.



4.3 conduct scientific research to provide the information and technology necessary for the conservation, restoration and development of fish habitats

DFO has a mandate to provide a scientific basis for protocols and technical guidelines for consistent assessment and quantification of fish habitat. The department has conducted surveys of critical estuarine and marine habitats of the lower Mackenzie River system and the Beaufort Shelf. Studies have also been conducted in Hamilton Harbour, Lake Ontario, on the effects on wetland vegetation of habitat alterations. A joint project funded by DFO, DIAND, DOE, YTG and the Klondike Placer Mining Association is studying the effects of placer mining on fisheries.

4.4 **encourage and support involvement by government agencies, public interest groups and the private sector to conserve, restore and develop fish habitats and promote the establishment of national and regional committees, foundations or boards to work co-operatively with the Department of Fisheries and Oceans**

As an important step in encouraging the involvement of others in fish management activities, DFO has prepared communications materials such as pamphlets, slide shows and videos. A Fish Habitat Improvement Guide has been published and distributed in New Brunswick and Newfoundland.

4.5 **undertake monitoring and assessment of fish habitats in support of federal fish habitat management goals and objectives**

Habitat evaluation studies have recently been conducted by DFO for two rivers on the Avalon Peninsula, Newfoundland; the La Have and Stewiacke rivers in Nova Scotia; the Montague River watershed in Prince Edward Island; and Carnation Creek and the Conuma River in British Columbia.

Information:
Fish Habitat Management Branch
Fisheries and Oceans
(613) 990-0201

5. PROVISION OF MUNICIPAL WATER AND SEWER INFRASTRUCTURE

Although municipal water and sewer systems fall within provincial/municipal jurisdiction, the federal government's most significant contributions to the construction of main trunk sewers, sewage treatment plants and certain water supply systems occurred from 1960 to the early 1980s, a period of rapid urban expansion. While the federal government continues to provide financial assistance for certain major projects, as outlined in II.5.6, it is encouraging the use of realistic pricing in the provision of water supply and treatment. Such a policy would not only raise the funds needed to build and maintain costly water supply and sewer systems, but would foster water-use efficiency.

5.1 participate with provinces in the examination of costs and pricing of municipal water supply and treatment

The federal government has undertaken extensive research of municipal water prices in Canada through the WAC of CCME. The results were published as a public information brochure and as a research paper.

5.2 advocate the pricing of water and sewer services at a level suitable to meet the development and rehabilitation of these services

DOE has funded a study of the benefits and costs of water metering for municipalities.

5.3 implement proper environmental and health practices with respect to federal undertakings

Federal initiatives are discussed under Part II, sections 3 and 6.

5.4 participate with provincial and municipal governments in developing the requirements and programs to deal with industrial discharges to municipal treatment systems

DOE collaborated extensively with Ontario in developing guidelines for the Municipal-Industrial Strategy for Abatement program, which will regulate industrial discharges, including those to municipal systems. A Remedial Action Plan for the Hamilton Harbour area included recommendations to deal with industrial discharges to municipal systems.

5.5 undertake, support and promote research, development and transfer of new wastewater treatment technology

Research has been carried out at DOE's Wastewater Treatment Technology Centre in Burlington into automating waste treatment plants. The Centre also has pioneered processes for producing petroleum-like materials from sewage treatment plant sludge. Both projects have proven to be commercially viable. The latter will be incorporated into the operation of the new Halifax municipal waste treatment plant.

5.6 consider financial assistance for projects that meet federal and provincial development priorities and are eligible for assistance under existing federal programs

Certain projects have been financially assisted under federal programs in instances where federal and provincial priorities coincide. These include the St. Lawrence River Environmental Technology Development Program to reduce industrial pollution by assisting the development and improvement of pollution abatement technologies (as part of the St. Lawrence River Action Plan) and a project under the Canada/Quebec Sub-agreement on the Economic Development of the Regions of Quebec, which explicitly permits the financing of infrastructure associated with industrial development. Under

this sub-agreement, a total of $24.5 million is being contributed towards a wastewater treatment facility associated with a pulp mill in Matane, Quebec. A Canada/Nova Scotia ERDA is supporting the construction of a sewage treatment plant in the Halifax-Dartmouth area. A Canada/Saskatchewan ERDA has contributed to the construction of a new water supply system for Regina. Under the Canada/Newfoundland Channel-Port aux Basques Water Improvement Agreement, a water supply and treatment plant was completed and opened officially in August 1988 with $6.5M federal support. PFRA is responsible for the federal delivery of the Canada/Saskatchewan ERDA Agricultural Community Water Infrastructure Agreement. The objectives are to allow for continued or enhanced community effectiveness in supporting the agricultural sector and to facilitate agricultural processing. The $32-million, five-year agreement, which expires in October 1990, provides for the construction and financing of water supply and/or waste disposal systems in some forty-two communities.

Information:
Water Planning and Management Branch
Inland Waters Directorate
Environment Canada
(819) 997-2071

6. SAFE DRINKING WATER

Protection and restoration of Canada's drinking water is a shared responsibility of the federal, provincial and municipal governments. The provinces are generally responsible for ensuring community potable water supplies, while the federal government has specific responsibilities such as for international and interprovincial carriers, federal lands and installations, and Indian reserves.

The increasing number of potentially toxic substances being detected in drinking water has heightened public concern. The federal government confirms its commitment to ensuring safe drinking water within areas under its jurisdiction and to promoting a consistent approach to protection and improvement of the nation's drinking water by the provinces, territories and local governments.

6.1 consider legislation to ensure the safety of drinking water within federal jurisdiction and to complement provincial and territorial programs

Canada is one of the few developed nations that does not have national drinking water legislation. NHW is examining the legislative options for drinking water, and plans are in place to introduce legislation for a Canada Drinking Water Safety Act, although no date has been set.

6.2 establish national drinking water quality guidelines to help all jurisdictions in setting safe drinking water standards

The "Guidelines for Canadian Drinking Water Quality -1978" were revised and published in 1987 by the Federal-Provincial Advisory Committee on Environmental and Occupational Health. The fourth edition of these guidelines was released in early1990.These guidelines form the basis of much provincial water quality objectives/standards legislation.

DOE is updating its guidelines for agricultural livestock watering.

6.3 conduct research and support technological development and transfer in drinking water treatment processes

NHW, assisted by DOE, le Ministère de l'Environnement du Québec and the City of Laval, is conducting research into the development of drinking water treatment processes. The focus has been on ozonation of water followed by biologically activated carbon (BAC) to reduce total organic carbon content and subsequent bacterial treatment needed. Pilot studies are under way. NHW's support is being given to a feasibility study on a number of biomonitoring methods to supplement chemical monitoring, including acute and chronic toxicity, mutagenicity, carcinogenicity and novel methods for the enumeration of viral and bacterial pathogens. In the Atlantic provinces, DOE, NHW and the health and environment departments of the Atlantic provinces conducted a four-year study on toxic chemicals in surface- and ground-water resources used for municipal and drinking water supplies; an interpretive report was completed in early 1990.

6.4 **promote public awareness and understanding of critical issues respecting drinking water safety, such as prevention of contamination of drinking water sources from land area runoff**

NHW has prepared issue papers on lead and aluminium in water and conducted studies in co-operation with NHW and provincial health departments to determine relationships between geochemistry and certain diseases. Pamphlets and posters on guidelines for drinking water and water quality were published in co-operation with DOE, and technical and public meetings were held to explain the basis of drinking water guidelines.

Information:
Health Directorate
Health and Welfare Canada
(613) 954-0291

7. WATER-USE CONFLICTS

Although Canada's overall water supply-demand balance is favourable, over 60 percent of river flow is carried to the North where only 10 percent of Canada's population lives. Many regions in Canada no longer enjoy clean water in abundance, and the potential for conflicts between users will increase as demands grow. Traditionally, water management in Canada has focused on regulating and diverting supplies to accommodate needs. The cost of meeting such demands has escalated, as has public opposition to the adverse social and environmental effects often associated with them. Some regions of Canada characterized by poor drainage give rise to another form of conflict characterized by the question "to drain or not to drain?" Economic and social benefits and disbenefits have been difficult to pinpoint. (See II.10.5.)

The approach to resolving water-use conflicts would appear to be that adopted by Western societies for most other resource allocations - the use of the price system and the interplay of the forces of supply and demand. Typically, water in Canada is underpriced if it is priced at all. Consequently, development of appropriate pricing mechanisms is seen as an effective way to encourage efficient water use and thereby to lessen the risk of conflict.

7.1 develop water demand management approaches in areas of federal jurisdiction with regard for varying social and economic conditions, and for intangible heritage and recreational values and encourage other jurisdictions to do the same

As a preliminary step in establishing demand management, a monograph entitled Water Demand Management in Canada: A State-of-the-Art-Review was completed by DOE in 1989. It outlines the philosophy and research requirements for a federal water demand management and conservation program.

7.2 undertake, support, and promote research into establishing appropriate prices for water, identifying areas of potential user conflicts, and encouraging the development and transfer of water conservation technologies and practices

A DOE study of water pricing in 1987 focused on municipal government practices. A further study is under way on water demand, and additional research into industrial water use is planned. These studies should prove useful to provincial and municipal governments and to the CCME, all of whom are looking at the question of water pricing.

The Halifax Harbour Agreement between Nova Scotia and DOE includes consideration of privatization of sewage treatment facilities, particularly as they relate to DOE research into producing oil from sewage sludge.

7.3 **encourage an integrated resource planning and management approach to augmentation and allocation of water supplies in order to ensure that the full range of values are considered**

The Canada/PEI Work Sharing Agreement signed in October 1987 is a three-year project which includes special surveys and demonstration projects related to ground water, surface water and the estuarine environment using a multisectoral and integrated water management approach. The cost of $1 million is shared equally.

The St. Lawrence Action Plan, announced June 3, 1988, commits the federal government to spending $110 million over a five-year period to implement a cleanup and protection plan for the St. Lawrence River and its ecosystems. A subsequent agreement signed in June 1989 by Canada and Quebec outlines the basis for federal/provincial co-operation to implement the Action Plan and the province's intention to allocate $61.5 million towards this effort.

The South Saskatchewan River Basin Study objective is to develop a framework plan for the sustainable development of the basin's limited water supplies. Various economic growth scenarios and water management alternatives are being evaluated to ensure sufficient supplies for the projected range of user needs. The $1.6 million cost of the five-year study, ending in March 1991, is shared equally by the two governments.

On the prairies, PFRA works closely with provincial agencies, communities, farmers, and NGOs to provide water for municipal and agricultural (irrigation and on-farm water) uses, for water-based recreation, and for waterfowl and fisheries habitat enhancement. It is now developing a broad strategy for agricultural water programming, which will take into account soil, water and land use.

The management plans developed under the CHRS program (see II.13.1) are designed to establish policies and procedures for the development of heritage rivers, taking into account the range of uses and demands on such waterways.

7.4 **promote and support public awareness and public participation in water conservation**

DIAND assists Indian bands to participate in federal and provincial assessment and regulatory processes on water use to ensure water planning takes native concerns into account. An example is the case of the proposed cottage development on the Shoal Lake Reserve, Manitoba, which may affect water supplies to Winnipeg.

DOE has developed and distributed the first three of a series of ten water fact sheets and has produced a video, "Water, Now is the Future." A comprehensive water question/answer booklet designed for the public has been developed. Printing is scheduled for March 1990. Another edition of the Canada Water Year Book series is being written on the theme of flooding in Canada. Of interest to professionals and the general public, this is the seventh in the series and provides a comprehensive picture of flooding from a Canadian perspective.

A pilot project to evaluate the effectiveness of building partnerships to encourage public participation in water conservation has been implemented by DOE. Pilot project partnerships have been entered into with the National Survival Institute, the Canadian Wildlife Federation and the Girl Guides of Canada.

DOE has also analysed public opinion, consulted experts and tested the receptivity of potential partners to the concept of a water awareness program. As a result, program objectives have been developed which include raising public awareness of water problems and solutions, building partnerships and encouraging action. Program messages are being developed and a range of mechanisms to carry the messages are being evaluated as part of a water communications strategy.

DOE's annual Environment Week activities have become a successful means of communicating with the public on water matters and of promoting conservation. With a DOE budget currently in excess of $1 million and in co-operation with various federal and provincial agencies and NGOs, the public and school children experience a variety of activities to familiarize them with the pressing environmental issues facing the country and the manner in which governments are addressing them. Activities include demonstration programs, field trips, an environmental boat cruise and a film festival.

Information:
Water Planning and Management Branch
Inland Waters Directorate
Environment Canada
(819) 953-3478

8. INTERBASIN TRANSFERS

More streams have been diverted in Canada than in any other country in the world. Considerable experience has been gained from major projects on the Nechako River in British Columbia, the Churchill River in Manitoba, la Grande rivière in Quebec, and other major hydro projects incorporating interbasin diversions. However, prior assessment of their socio-economic and environmental implications was limited, and much was learned through trial and error. Within Canada, the federal government advocates exercising caution in considering major interbasin transfers and endorses other, less disruptive alternatives such as demand management and water conservation.

Federal action on the controversial issue of water export is necessary to reduce longstanding public concerns for protecting Canada's water heritage and to preclude major project expectations which may otherwise develop on either side of the international border.

8.1 **draft guidelines and criteria for assessing interbasin transfers within Canada in co-operation with the provinces/territories**

DOE is preparing a background document on criteria for the environmental assessment of interbasin transfers of water within Canada. To date, only Quebec has indicated interest in new interbasin transfers of water within Canada.

8.2 **take all possible measures within the limits of its constitutional authority to prohibit the export of Canadian water by interbasin diversions; and strengthen federal legislation to the extent necessary to fully implement this policy**

In August 1988, the federal government introduced the Canada Water Preservation Act (Bill C-156) in Parliament. The Act is designed to put the principles of the FWP into effect by forbidding the large-scale export of water by diversion and establishing conditions for the small-scale export of water. The Bill was not passed before Parliament rose in October of that year.

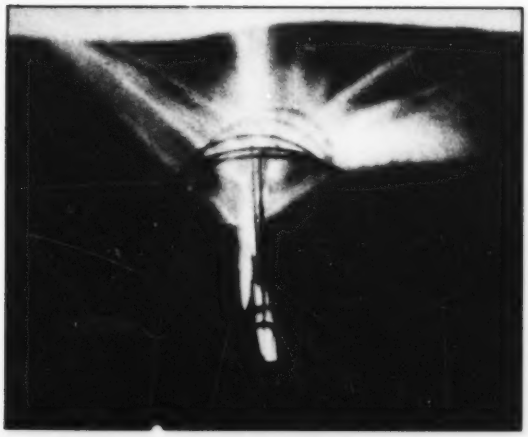
8.3 **develop with concerned provincial governments a mutually acceptable referral system to ensure that provincial licensing of small-scale transfers of water (local arrangements between communities, or containerized transfers) between jurisdictions take into account federal interests respecting navigation, fisheries, environmental protection, Indian Treaties and trade considerations**

At present, a formal referral system on provincial licensing of small-scale exports of water has not been instituted. Federal and provincial environment officials co-operate closely to ensure that proposed small-scale exports of water are not environmentally damaging and are conducted in accordance with federal responsibilities for international trade and environmental protection.

Information:
Water Planning and Management Branch
Inland Waters Directorate
Environment Canada
(819) 953-1513

9. WATER USE IN IRRIGATION

Irrigation continues to be promoted as a means of overcoming the semi-arid conditions of much of western Canada. The federal government continues its assessment of irrigation practices with a view to striking a long-term balance between economic, environmental, and multi-use objectives.



9.1 continue to support the best possible use of existing irrigation facilities through research and encourage efficient water use

The PFRA demonstration farm at Outlook, Saskatchewan, was upgraded in 1986 at a cost of $900,000 and renamed the Canada/Saskatchewan Irrigation Development Centre. Jointly operated by PFRA and the Saskatchewan Water Corporation, the Centre was established to increase applied irrigation research and demonstration activity in Saskatchewan and continued to do so during 1989/90 with a budget of seven person-years and $456,000. The general focus is on investigations/ demonstrations which can later be implemented by farmers. The long-term success of the Centre hinges on its ability to provide farmers with viable alternative cropping options (diversification effort) and increased irrigated crop productivity (intensification effort) on a sustainable basis.

In 1986, the Canada/Saskatchewan Subsidiary Agreement on Irrigation Based Economic Development provided $100 million over five years for various activities related to the sustainable use of irrigation. For example, a process has been initiated for evaluating proposals for shared federal/provincial investment in irrigation works. Under Program 2, $15 million has been allocated to economic development, diversification and support activities related to irrigation. Under Program 3, PFRA is administering $10 million to improve the efficiency of Canada-owned irrigation systems and supply works in southwest Saskatchewan.

Technical investigations being carried out by DOE under the Canada/Saskatchewan South Saskatchewan River Basin Study will assist provincial management agencies to develop management tools to allocate scarce water supplies among competing uses such as hydroelectric power, irrigation, and domestic and instream uses. Irrigation expansion in the range of 60,000 hectares is planned. This will place considerable demand on the water resources of the basin. The final report on the South Saskatchewan Study is expected in December 1991.

Concerns over the use of pesticides have already been commented on under Part II, sections 2 and 3. DOE continues to conduct research to support the use of existing irrigation facilities through its pesticide field studies of irrigated areas.

9.2 support new development under economic development agreements, but only when it is based on a comprehensive set of considerations including;

- **availability of long-term market opportunities;**
- **potential for diversification and value-added processing;**
- **improvement in the viability of rural communities;**
- **improvement in the level and stability of profit for individual farmers;**
- **opportunities for other complementary multiple water uses; and**

- **availability of a comprehensive environmental and economic impact**
- **assessment of local, regional and national economies**

Approval procedures of irrigation-based economic development agreements correspond to these guidelines. New irrigation systems are based on pressurized pipeline technology, which helps minimize adverse environmental impacts and contributes to efficient water use.

9.3 **encourage evaluation criteria consistent with federal development initiatives including social, environmental and economic factors, and opportunity costs**

PFRA applies multidisciplinary, analytical expertise to the study of irrigation development proposals from initiation to implementation. Projects are supported when they are economically beneficial to both society and irrigators. Evaluation of a project includes direct benefit-cost calculations, assessment of environmental impacts, social impacts and regional impacts.

DOE is planning a workshop to develop guidelines for the initial environmental evaluation of irrigation projects and continues to provide advice to other agencies on the environmental implication of irrigation proposals.

9.4 **encourage the development of realistic pricing and water conservation technologies and programs, and information programs directed to water conservation** ***(see Part II, sections 9.1 and 19.1)***

PFRA has recently increased fees for projects operated in southwest Saskatchewan. The new fees do not yet cover project operating costs; however, they represent a better balance between fees charged on provincial projects and the highly variable supply of water. An evaluation currently under way will assist in reviewing the present delivery charge rate structure.

9.5 **ensure that international and interprovincial apportionment requirements are met**

The Water Survey of Canada continues to monitor flows at the international boundary in order to ensure that commitments under the BWT and other Canada/U.S. arrangements are met. Other agencies such as PFRA ensure that irrigation and related projects on international streams are operated in a manner consistent with Canada's obligations. Interprovincially, federal officials co-operate with the provinces, as in the case of the PPWB's Master Agreement, to monitor flows at the provincial boundaries to ensure that apportionment conditions are observed.

Information:
Prairie Farm Rehabilitation Administration
Agriculture Canada
(306) 780-6671

10. WETLANDS PRESERVATION

Wetlands* are unrivalled sites for Canadians' enjoyment of some of this country's choicest ecosystems. The resources they hold, including rich wildlife and waterfowl habitat, recreation areas, sites for sustainable horticultural peat production, forest products, and rice and hay commercial harvesting ventures, are vital to Canadians. Wetlands also form a major source for much of North America's freshwater supply and act as natural protective zones against erosion and storm damage to many river, lake and coastal shorelines. Wetlands also function as ground-water recharge zones and, in some cases, may act as pollution filters, capturing and holding water-borne pollutants (e.g. heavy metals, sewage sludge) in wetland flora systems.

Canadians are the trustees of almost one quarter of all of the world's wetlands, currently covering 14 percent of the surface area of Canada. However, we face a crisis! These highly valued wetland ecosystems, which generate over $10 billion in economic benefits to Canadians each year, are being lost to competing demands for land use. Drainage programs, in particular, have presented a dilemma for all levels of government, pitting the ecological/environmental values of wetlands and wetland functions against the economic values of drained land for agriculture, peat and other forms of development. Government programs of wetland acquisition and subsidies for drainage can and do appear contradictory and counterproductive. Infilling and land degradation caused by decline in soil and water quality also result in losses. Over 20,000,000 hectares (13 percent) of the wetlands Canada once had have been lost.

10.1 reviewing and seeking to minimize the negative impact of federal policies, programs and activities on wetlands

A Federal Policy on Wetland Conservation, including an implementation plan, is under preparation and is expected to be finalized in 1990. One policy strategy focuses on exemplary management of wetlands on federally protected lands. A second focuses on federal program design and implementation. The goal is one of no net loss of wetland functions on federal lands or waters in those areas where the continuing loss or degradation has reached critical levels or where wetlands are important ecologically or socio-economically. The policy calls for creation of a National System of Secured Wetlands, which recognizes wetlands of national significance.

DOE continued its review of Environmental Impact Statements to ensure minimal impact of federal programs and activities on wetlands. It reviews all federal land transaction proposals to ensure that federal lands (including wetlands) are managed in an environmentally sustainable manner. Work has also started on a Federal Strategy for Sustainable Development, expected to be completed in 1990-91. It will identify federal actions required to achieve the wise use and management of resources, including wetlands, and will be developed co-operatively with other government and private-sector interests.

The guidelines manual for the Federal Policy on Land Use has been completed and is now being incorporated into the programs of other federal departments. The guidelines call for consideration of a wide range of land uses, including agriculture, forestry, habitat and water conservation within a framework of integrated planning.

DOE's CWS is negotiating agreements with several provincial governments to encourage limitation of expenditures of federal and provincial funds on projects that would impact on sites now identified as highly valued wetlands under its Wetland Protection, Mapping and Designation Program covering Prince Edward Island, Nova Scotia and New Brunswick.

DIAND has responded to the particular interest of Canada's native peoples in the preservation of wetlands. Funding has been provided to various bands such as the Pas and Walpole Island bands to assist them in expressing their concerns about off-reserve developments threatening their wetlands interests.

* A wetland is an area that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment. Wetlands include bogs, fens, marshes, sloughs, potholes, swamps and shallow waters (2 m or less).

10.2 **Identifying, conserving and managing wetlands of importance on federally owned or regulated lands**

The federal government manages 45 percent of all heritage lands in Canada on over 330 federal conservation-focused properties. DOE continues its management of forty-five national wildlife areas and the administration of ninety-nine migratory bird sanctuaries. Numerous national parks have wetland interpretive programs and two Ramsar sites (see II.10.6) are in national parks (Point Pelee and Wood Buffalo National Parks).

The administration of DOT lands at Boundary Bay, British Columbia, has been transferred to the CWS to protect the area's resources under the *Canada Wildlife Act*.

The PFRA community pasture program continues to ensure that large portions of land, much of which contains wetland areas, are maintained in a pristine condition. CWS has designated 106,000 hectares of Canada Land Inventory Waterfowl Class 2 and 3 habitat in Saskatchewan and Manitoba pastures. The replacement cost of these prime production areas is estimated by CWS to be $27.5 million. In Saskatchewan, the Department of Parks and Renewable Resources has estimated that the 610,000 hectares of native vegetation and wetland in PFRA pastures represents about 8 percent of the remaining native vegetation and wetland in agricultural areas. More than half of this, 371,000 hectares, has been classed as "critical wildlife habitat" and constitutes 9 percent of such habitat remaining in Saskatchewan.

10.3 **co-operating with other governments in conserving and managing wetlands which serve important hydrological roles associated with improving water quality, sustaining water quantity, and moderating flood events**

PFRA continues to be involved in the construction of major storage projects which, although designed primarily for irrigation purposes, provide a significant total surface area of water and a stable replacement for waters lost from drained sloughs and potholes. When operated for flood control purposes, the storage acts to moderate flood events.

10.4 **encouraging appropriate land-use practices, integrated land and water resource planning, and application of environmental assessment processes and practices to mitigate undesirable effects on existing wetlands**

PFRA's policy is to ensure that the environmental implications of all proposals for which it has federal decision-making authority are considered as early as possible in the project planning and assessment process, and before any irrevocable decisions are taken. It is also PFRA policy to comply with EARP and the 1984 EARP Guidelines Order.

PFRA's soil conservation programs, through the National Soil Conservation Program (NSCP), encourage producers to adopt appropriate land-use practices. On-farm planning services for sustainable agriculture and integrated land and water resource use are available. Through the Permanent Cover Program, erosion-prone land that is marginal for annual crops is being converted to more sustainable uses. Farmers are converting land to permanent forage, with associated benefits for habitat. Co-operative ventures are under way with organizations such as Prairie Care and Ducks Unlimited to convert marginal cropland located near wetlands to direct wildlife and waterfowl uses.

The North American Waterfowl Management Plan (NAWMP) (see II.10.6) and the Federal Policy on Land Use (see II.10.1) are very much land-use planning vehicles.

10.5 **conducting and promoting research to provide scientific and technological support for and understanding of wetland functions and values**

The Federal Policy on Wetland Conservation will strongly promote research and the assessment of wetlands functions and values, particularly those relating to the hydrologic cycle, shoreline resources and integrated resource management. The Prairie Conservation Action Plan, an initiative of the World Wildlife Fund and a variety of other agencies, is a five-year program to influence policy and attitudes in order to conserve prairie ecosystems and wildlife. An integral part of this initiative is the protection of productive wetland habitat.

A better understanding of the scientific processes at work in wetlands is gained through studies on wetland hydrology and the impact of climate change at NHRI in co-operation with McMaster University and Ducks Unlimited. NHRI also completed a report providing an assessment of economic values within the wetlands area of the Upper Bay of Fundy. NWRI, in collaboration with the Canadian Institute for Research in Atmospheric Chemistry, is investigating the role and the contribution of wetlands to the global cycle of methane, a greenhouse gas.

CWS, by means of case studies, is further developing methodologies by which the value of wetlands can be assessed. A manual on evaluation methods for wetlands is to be completed by 1990-91.

10.6 pursuing co-operative international and federal-provincial habitat protection, research and management programs for fish and waterfowl, as agreed under treaties, conventions and other bilateral agreements

CWS, in co-operation with the U.S. and Canadian federal and provincial/territorial/state governments, and with major NGOs, is implementing the NAWMP, a $1.5 billion Canada/U.S. agreement for waterfowl habitat restoration and protection (waterfowl, soil and water conservation) over the next fifteen years. A federal contribution of $30 million over the next five years has been approved. The plan targets over 2 million hectares of wetlands in Canada over the years 1986 to 2000. Four joint ventures have been established (Prairie Habitat, Eastern Habitat, Black Duck, and Arctic Goose) and eight first-step projects were undertaken in 1988-89.

Numerous migratory bird sanctuaries are managed by the federal government in direct co-operation with provincial governments (see II.10.2). CWS has developed a co-operative waterfowl management plan with British Columbia, which has a significant habitat component. Saskatchewan is in the process of transferring up to 15,000 hectares of provincial Crown lands to the federal government to protect key wildlife habitat.

The Ramsar Convention on Wetlands of International Importance was drafted in 1971 and is currently ratified by fifty-one countries to promote conservation of wetlands, especially for waterfowl habitat. Additional Canadian sites have recently been submitted to the International Union for Conservation of Nature and Natural Resources for inclusion in the Ramsar list, bringing the Canadian total to thirty. These thirty sites cover 13 million hectares, an area consisting of 43 percent of the 409 wetland areas identified worldwide under this convention.

10.7 promoting public awareness of wetland values and public participation in the conservation of wetlands

CWS is actively promoting wetland values through publications and exhibits at conferences and public events. A systematic study of Canada's wetlands, "Wetlands of Canada," was published by CWS in 1988. The authors of this book, the National Wetlands Working Group of the Canada Committee on Ecological Land Classification, are provided support by CWS. CWS also published the "Canadian Wetland Classification System" in 1987 and developed a memorandum of understanding with the Federation of Ontario Naturalists to distribute the "Ontario Wetlands Map Series." A joint publication of the CWS and Wildlife Habitat Canada, "Wetlands are not Wastelands," was released in 1988. The popular "Wetlands" fact sheet was updated in 1989. Two issues of the Ramsar Newsletter have been published, and a third will be available in 1989-90 through CWS support of the Ramsar Convention.

Information:
Canadian Wildlife Service
Environment Canada
(819) 953-1447

11. HYDROELECTRIC ENERGY DEVELOPMENT

Hydroelectric power, a renewable resource, has been the mainstay of electrical generation in Canada, and in 1988 provided 63 percent of the electricity needed. Nuclear and conventional thermal power plants accounted for the remainder. The development and management of non-nuclear electrical energy production sites and facilities is under the legislative authority of the provinces. The high cost of fossil fuels is making small-scale and low-head hydro appear increasingly attractive. Small-scale hydro units are economically feasible for isolated communities. In addition, this technology has an export potential to developing countries.

11.1 contribute to energy research and development, particularly when small-scale and low-head technology are involved

Research and development initiatives in this area have been sponsored by EMR's Interdepartmental Panel on Energy Research and Development (PERD).

PERD funds were used by the Energy Diversity Division of EMR, which is responsible for federal research and development of small-scale and low-head hydro including tidal power. More than ten projects were completed during 1988-89 and included resources assessment techniques and computer modelling, civil works and structure design techniques, turbine and generating product development, tidal energy studies, and technology and information transfer.

Hydrology methodologies have been developed to assist small-scale hydro developers and planners, and since 1984 DOE has undertaken studies applicable to ungauged small-scale hydro sites in most provinces. These methodologies are equally useful for other water planning and management activities, such as industrial, municipal and agricultural water uses.

EMR's Electrical Energy Branch provides financial support to the Canadian Electrical Association's Research and Development Program. This R&D program includes the design, operation and environmental improvement of many large-scale hydroelectric power projects and is at the leading edge of hydroelectric R&D in Canada.

11.2 encourage integrated planning at sites where federal interests or financial support are involved or when more than one province is affected

Integrated planning has been encouraged by EMR through co-operation with provincial agencies under such programs as the ENERDEMO program, which allows for small hydro demonstrations at sites across Canada. Some sites are located at federal land waterways (St. Lawrence Seaway and the Trent-Severn Waterway). Limited demonstration of small hydro projects are also carried out under the Remote Community Demonstration Program.

EMR, in association with the Tidal Power Corporation of Nova Scotia, conducted assessment studies and research to examine Bay of Fundy tidal power opportunities.

11.3 compile and disseminate national statistics on dams and electric power in Canada

EMR and DOE are involved in compiling and disseminating national statistics on dams and electric power in Canada.

EMR has compiled and disseminated information on small hydro and low-head hydro resources in Canada in co-operation with provincial agencies. For example, EMR has contracted a small hydro sites study in British Columbia and, in co-operation with the Newfoundland and Labrador Hydro, contracted a small hydro resources study in Newfoundland. Material developed by EMR on small hydro sites and potential sites was brought together in a paper given at the 1988 Small Hydro International Conference in Toronto and for courses for developers. EMR provided support for a private company to issue the quarterly Small Hydro Newsletter and produced the annual report Electric Power in Canada.

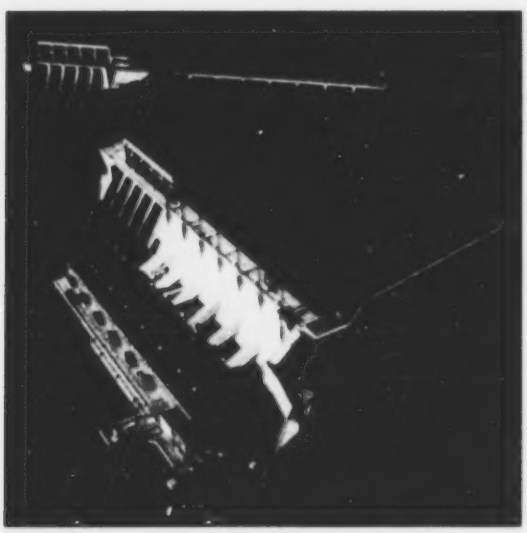
DOE has developed a data system, REGDAMS, which incorporates data for large dams in Canada, and publishes statistics twice a year on water charges for hydroelectric power generation through contact with power companies in Canada.

11.4 encourage use of the Environmental Assessment and Review Process or a provincial equivalent, so that potential adverse environmental and socio-economic consequences can be identified before implementation and, to the extent possible, mitigated

Since the FWP has been in effect, no hydroelectric developments have required reference to the Minister of the Environment for public review by an independent panel under EARP. However, following the court decision on the Oldman River, it now appears that a number of hydroelectric projects across the country will now require the application of EARP (e.g. Site C on the Peace River, several developments in northern Ontario, and James Bay II in Quebec).

Consultation and reform of the EARP with a view to legislation was completed in 1988. The intent of the legislation would be to strengthen the initial assessment phase and ensure that major water projects receive appropriate review.

DIAND has been involved in the resolution of concerns associated with a number of hydro projects. The issues generally arose because Indian concerns with regard to reserve flooding, impacts on hunting, fishing and trapping, or on water quality were not taken into account during project planning. In one such involvement, DIAND signed the Northern Flood Agreement in 1977 with five bands, the Manitoba government and Manitoba Hydro. The federal government has discharged its major obligation under the agreement for water and sewer services by providing $88 million to the bands. Negotiations between the four parties to resolve outstanding issues commenced in February 1989 and are ongoing. In other instances, DIAND provided assistance and funding for the resolution of concerns associated with the W.A.C. Bennett Dam in British Columbia and the Grand Rapids Forebay project in Manitoba. The department also signed an agreement with the Michipichoten band, Ontario and the Great Lakes Power Corporation to compensate the band for an upstream hydro project.



Information:
Office of Environmental Affairs
Energy, Mines and Resources Canada
(613) 996-6424

12. NAVIGATION

Under the *Constitution Act*, specific power over navigation and shipping has been vested in the federal government. Several acts deal with this topic, including the NWPA, which protects the public right of navigation through the regulation of structures placed or built in the navigable waters of Canada. The Act applies to all navigable waterways in Canada which are used for purposes of commerce, transportation or recreation.

In keeping with federal objectives to provide for a safe, efficient and economic national marine transport system, federal navigation agencies co-operate with other federal, provincial, territorial and international agencies to ensure the protection of water quality in the marine environment while recognizing competing water uses.

12.1 continue to administer and enforce legislation related to navigable waters, in particular the *Navigable Waters Protection Act* and associated regulations

Administration of the Act by DOT's Canadian Coast Guard is an ongoing activity, with an annual budget of $2,600,000 and thirty person-years. A long-established approval process provides for on-site inspections, consultation with other government departments and public input on major works such as bridges and dams.

12.2 consider amendments to the *Navigable Waters Protection Act* so as to define "navigable waters," strengthen the approval process for major works and streamline the approval process for minor works

A proposal to amend the NWPA is a DOT priority. Changes being recommended include a definition of the term "navigable waters" and the establishment of a tiered level of approval which would be based on the type and magnitude of the work. A discussion paper will be disseminated to the public and private sectors for comment. Preliminary information on the substance of the proposed changes has been circulated to government departments through the ICW and to the marine community through the Canadian Marine Advisory Council.

12.3 continue to play the lead role in the development, modification or improvement of works in main commercial shipping channels under federal jurisdiction, and influence or provide advice with regard to works in secondary commercial shipping channels

The development, modification of improvement of works in main commercial shipping channels under federal jurisdiction is subject to the provisions of the NWPA and to specific legislation such as the *Canada Ports Act* and the *St. Lawrence Seaway Authority Act*. Works in secondary commercial shipping channels are also subject to the provisions of the NWPA. DOT is the lead agency in the endeavour.

12.4 continue to apply the Environmental Assessment and Review Process to water-related projects

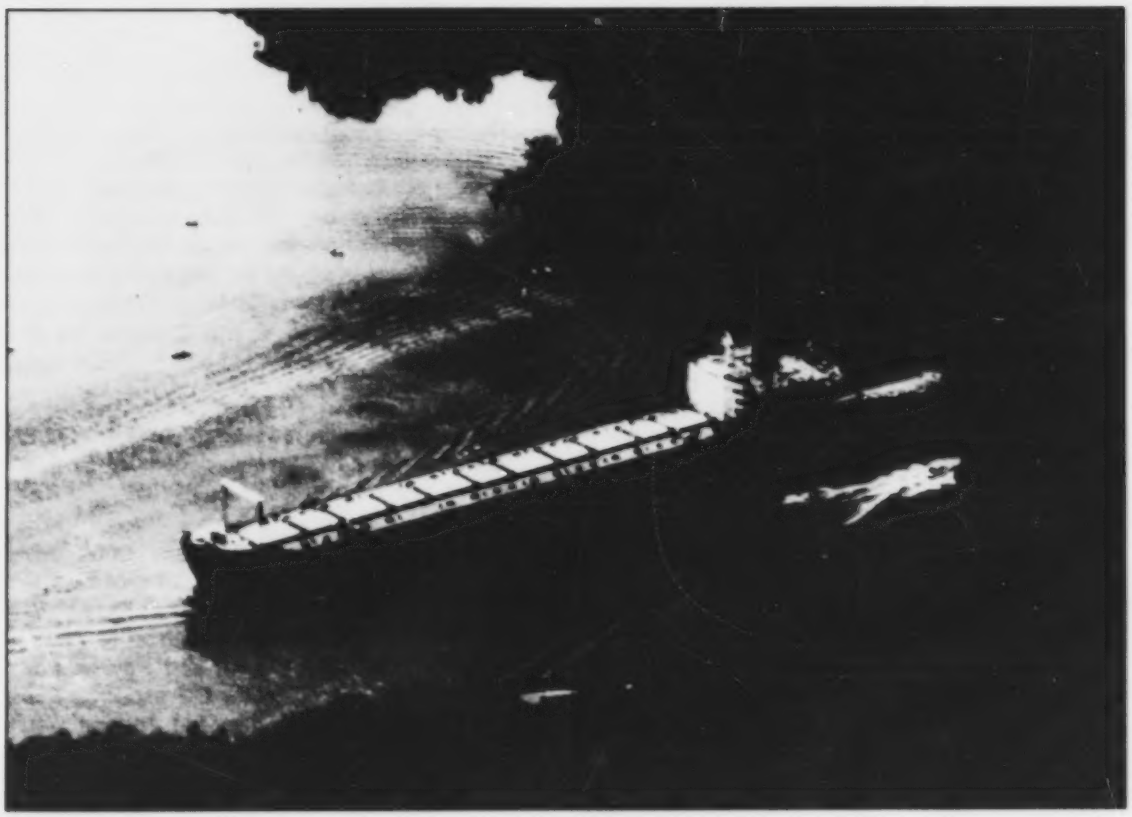
The October 4, 1989, a Federal Court decision concerning the proposed damming of the Oldman River stated that the application of the NWPA to a project was not a sufficient reason to invoke the Environmental Assessment and Review Process (EARP). The "Friends of the Oldman River Society" appealed this decision to the Federal Court of Appeal. The decision by the Federal Court of Appeal of March 13, 1990, quashed the NWPA approval of September 18, 1987, and ordered the Minister of Transport and the Minister of Fisheries and Oceans to apply the EARP Guidelines Order to the project.

12.5 continue actively to support, national, international, provincial and territorial initiatives relating to good management of water resources where navigation is involved

The concept of inter-governmental initiatives to enhance navigation within the sphere of sound water resource management has long been practised on Canada's rivers. Federal/provincial

negotiations are currently under way with respect to transboundary water management to ensure that commercial navigation in northern rivers is not impeded.

As a result of studies conducted under the Great Lakes Water Quality Agreement of 1978, concern was expressed in both Canada and the United States over the discovery of non-native species of marine life in the waters of the Great Lakes. On April 1, 1989, voluntary guidelines were put in place to discourage the discharge of seawater from ships entering the St. Lawrence Seaway System. The intent of these guidelines is that all ships destined for the St. Lawrence Seaway and the Great Lakes exchange their ballast far enough from any coastline so that there will be few organisms of any kind in the exchanged ballast water.



Information:
Navigable Waters Protection Act Office
Transport Canada
(613) 998-1415

13. HERITAGE RIVER PRESERVATION

Canada's rivers are a priceless and irreplaceable part of our natural and cultural heritage, and they continue to play a large part in our working and leisure hours. A number of river environments are in danger of being seriously compromised or polluted, and many historical resources along these river corridors could be damaged or lost forever. In response to these challenges, the federal government, through a CPS lead and with the co-operation of provincial and territorial governments, has developed a nationwide system of heritage rivers and established the Canadian Heritage Rivers System (CHRS) Board to administer the CHRS.

13.1 co-operate with provincial and territorial governments through the Canadian Heritage Rivers System to give national recognition to Canada's important historic, natural and recreational rivers or river segments, regardless of which government has jurisdiction over these waters

Co-operative management plans have been developed under the CHRS program to establish policies and procedures for the development of heritage rivers, taking into account the range of uses and demands on such waterways.

Segments of five rivers in northern and western national parks and the Grand River in Ontario are recent "designations" to the Heritage Rivers Program. These, plus a section of the Yukon, Kozan and Thelon rivers, which were jointly "nominated" by DIAND and the NWT government, bring the total number of rivers in the program to eighteen.

The CPS has prepared a draft policy to outline its role in the program, and has co-operated with provincial and territorial governments on the development of program policies.

13.2 staff and operate a secretariat for the Canadian Heritage Rivers Board

Federal funding is provided for the positions of secretary and assistant secretary to the CHRS Board. The CHRS program secretariat, housed in DOE, has facilitated contact between federal, provincial and territorial agencies and NGOs.

13.3 provide technical and financial assistance to provincial and territorial governments for studies leading to the nomination of rivers to the Canadian Heritage Rivers System and for preparing management plans for the rivers, once nominated

Over $120,000 per year is provided by the CPS for studies such as were carried out on seven rivers in Nova Scotia, twenty-two in New Brunswick, one each in Ontario, Quebec and Yukon, two in Manitoba and two in the Northwest Territories. Technical resources were also provided to ensure that CHRS planning is co-ordinated with all appropriate agencies.

13.4 **publicize the Canadian Heritage Rivers System both nationally and internationally**

A total of $60,000 per year is provided for printing fact sheets and other publications on CHRS, constructing exhibit kiosks, publishing annual reports, developing audio-visual presentations and responding to public requests for information.

Information:
Canadian Heritage Rivers System Board
c/o Parks Service
Environment Canada
(819) 994-2690

14. MANAGEMENT OF NORTHERN WATER RESOURCES

Canada's North has a very sparse population and little municipal or industrial development. As a result, most of the northern water resources remain in pristine condition. This resource has a special value in the North as the breeding grounds for the majority of North America's migratory birds, as a means of transportation, and as a sustaining force for native lifestyles. Water is also one of the main economic resources for the North's future, particularly with respect to hydroelectric development and resource industries.

The federal government is committed to the conservation, development and use of northern water resources for the greatest social and economic benefit of northern Canadians and will work co-operatively with the territorial governments.

14.1 to provide a framework within which all northerners can participate in the planning and management of water projects that may affect their lifestyles and/or livelihood;

and

14.2 to maintain conditions that will ensure traditional water values are sustained, yet not sacrifice economic activities and opportunities for the region;

and

14.3 to encourage good conservation practices now so that adequate water supplies will be assured for future uses

These three policy statements describe the water management goals of DIAND.

Through the administration of the NIWA, the department has in place a regulatory framework for conservation and protection of water resources while still providing an environment for economic development. Public participation in the regulatory process is a cornerstone of the Act inasmuch as it requires the Northwest Territories and Yukon Water Boards to hold public hearings on water licence applications. The terms and conditions included in water licences strike a balance between the requirements for sustainable water use, including traditional water uses, and proposed development activities.

14.4 to establish mechanisms with the provinces regarding (trans) boundary waters to ensure that the region's interests are protected

DIAND, in co-operation with the Government of the Northwest Territories, is negotiating bilateral transboundary water management agreements with the provinces of Alberta and Saskatchewan and is assisting in the development of an NWT/Yukon agreement. Preliminary draft agreements have been prepared based on the principle of joint co-operation and management and on equitable and fair use of common water resources.

DIAND, DOE and DOT are represented on the Mackenzie River Basin Committee, which is currently reviewing options for the development of a master agreement with the three westernmost provinces for the management of the shared water resources of the Mackenzie River basin. DIAND's Northern Advisory Group held an "interests and needs" workshop in 1988 to identify the key concerns of federal agencies in these negotiations and to develop a strategy to ensure the interests of northerners are protected.

DOE is involved with DIAND, DFO, British Columbia and the Yukon in the development of an Agreement Respecting Water Resource Management and Information Exchange in the Yukon and Alseck river basins. This agreement is expected to be signed soon.

14.5 **to review the *Northern Inland Waters Act* with a view to producing legislation that responds better to the present needs of the North**

DIAND received Cabinet approval in August 1988 to amend the NIWA following a year of extensive consultation with northern groups. The amended Act will contain many new provisions that respond to the changing political and economic climate of the North, and the needs of northern water users. The bill is expected to be tabled in Parliament in the spring of 1990.

14.6 **to employ environmentally sound practices in development projects**

All development projects in the North are subject to environmental screening and possible formal environmental review and assessment. DIAND's regulatory and administrative framework provides for consultation with and technical advice from other federal and territorial government departments, industry sectors and the public. The Canada Oil and Gas Lands Administration (COGLA) consults DIAND with regard to environmental protection in oil and gas frontier activities.

EMR implemented the Remote Community Demonstration Program, which included small hydro feasibility studies in northern Canada.

14.7 **to integrate northern water resources planning within a framework involving all northern resources**

DIAND, the government of the Northwest Territories and DOE are working co-operatively on a proposed Yellowknife River Basin Study which will ensure that planning activities are undertaken in the broader context of northern resource development. DIAND and DOE prepared a proposal to expand the hydrometric network in the North and to implement an integrated water resources network for the Mackenzie River basin.

DIAND, the Yukon territorial government and the Council of Yukon Indians have signed an agreement on Land Use Planning to develop and apply social, economic, cultural and environmental policies in the management of renewable and non-renewable resources in the Yukon.

Information:
Water Planning and Management Branch
Indian and Northern Affairs Canada
(819) 997-0559

15. NATIVE WATER RIGHTS

Water has a special value as a sustaining force for traditional lifestyles of Canada's native people. In recent years, native people have demonstrated interest in management of water resources. In this way, they are taking positive steps to protect their distinctive way of life and to determine their own destiny. The federal government recognizes native people's special interest in water and is striving to balance the goal of maintaining natural conditions and thereby protecting traditional uses, with the goals of others directed to resources and economic development.

15.1 negotiate land claims settlements that define use and management powers for waters within claimed areas

The Government of Canada, through DIAND, has concluded negotiations with the Dene/Metis in the western NWT, the Tungavik Federation of Nunavut in the eastern NWT, and the Council of Yukon Indians. Agreements in Principle, signed over the last two years, set out provisions for native participation on land and water management boards. They confer certain rights for native use of water and provide compensation for loss of such rights.

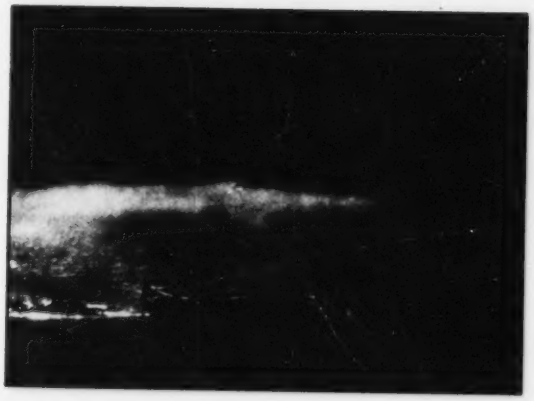
15.2 review and clarify with native people their water-related issues and interests with respect to their treaty areas as well as to lands subject to land claims;

and

15.3 improve understanding of native needs and commitments associated with water;

and

15.4 determine, in consultation with native people, how they will participate in resource management programs affecting water resources of interest to them;



and

15.5 encourage greater native participation in water allocation and management decisions involving instream and traditional uses

These four policy statements describe ongoing functions and activities of DIAND, especially in Canada's North.

DIAND has sought to clarify native water-related issues and interests with respect to native reserves, treaties and traditional use areas. The department continues to improve understanding of native needs in these areas and to foster native participation in water allocation and management decisions. Native people have been and are represented in both the Yukon and Northwest Territories water boards. DIAND has also funded studies in British Columbia to address native water issues. Funds have been provided to a number of bands involved in direct discussions of water allocation, water quality and other management issues with provincial and hydroelectric company officials.

Information:
Water Planning and Management Branch
Indian and Northern Affairs Canada
(819) 997-0559

16. CANADA–U.S. BOUNDARY AND TRANSBOUNDARY WATER MANAGEMENT

While Canada/U.S. affairs have for the most part been conducted in considerable harmony, there has been, on occasion, some discord over various social and economic issues. This, however, has rarely been the case in the management of transboundary water resources due to the BWT, a remarkable piece of legislation which, although developed in 1909, was created with such foresight and flexibility that it still remains relevant today. Administered by the International Joint Commission (IJC), the Treaty has so far been responsible for more than 100 amicable settlements of potential international conflicts involving either the quality or quantity of transboundary waters.

16.1 ensure that both nations adhere to the Boundary Waters Treaty when managing boundary water matters

There are many instances of the BWT influencing the management of boundary waters. For example, recently the United States proposed diverting additional water out of Lake Michigan (the Chicago diversion) to improve navigation on the Mississippi River system. Facing strong opposition by Canada and also by some Great Lakes states, the United States government decided to pursue other alternatives for regulating flows throughout the Mississippi system. Another example is the implemention of the Great Lakes Water Quality Agreement of 1978. Both Canada and the U.S. continue to develop remedial action plans for severely polluted areas. Efforts to clean up the Niagara River are progressing gradually under the four-party Niagara Toxics Management Plan, signed in February 1987 by the U.S., Canada, Ontario and New York State. Work on the Niagara River led to a four-party Lake Ontario Toxics Management Plan in January 1989.

16.2 regulate development on the Canadian portion of international rivers to ensure that transboundary implications are taken into account

In April 1989, the Federal Court quashed the IRIA licence for the Rafferty-Alameda Dams Project on the Souris River, citing a duty of the DOE minister to follow the EARP guidelines. A new Initial Environmental Assessment was completed in September 1989, and the project was allowed to proceed, but under stringent conditions. Following a further court challenge, work was halted on December 28 pending a full environmental review under the DOE EARP. A five-person EARP panel was appointed in late January 1990.

16.3 consider IJC recommendations on boundary water issues, with a view to ensuring Canadian needs are addressed in the spirit of international co-operation

IJC recommendations generally have important implications for boundary water management. In its third biennial report (March 1987) on the Canada/U.S. Great Lakes Water Quality Agreement, the IJC recommended that greater efforts were needed to control toxic pollution. A Protocol to the Agreement was signed in November 1987 leaving the Agreement largely intact, but updating and strengthening it with a series of new annexes: remedial action plans for areas of concern, lakewide management plans, ground-water pollution, contaminated sediments, airborne toxic chemicals and research and development. Negotiation of the Protocol included representatives from Great Lakes United, a major environmental organization, on both the Canadian and U.S. delegations. An additional $125 million in federal money was allocated through the Great Lakes Action Plan to the Great Lakes cleanup effort in October 1989.

Another IJC recommendation with significant implications was contained in its report on the water quality of the Flathead River in relation to a planned coal mine development in British Columbia that might affect waters which flow to Montana. The report recommended that the mine proposal not be approved.

16.4 **refer international disputes to the agency deemed by both governments to be best suited to handle them, normally, but not exclusively, the IJC**

Existing international agencies, including the IJC, were responsible for responding to a number of international disputes as they arose during the period in question.

16.5 **participate with and support that agency to ensure that it has adequate resources, especially if requested to take on additional tasks or major studies**

The federal government continued to provide water management expertise and funding to both the IJC and non-IJC international agencies (see II.2.5). It participated in thirty IJC boards dealing with water management across the Canada/U.S. boundary.

Increased funding ($1.6 million for the Canadian contribution over fiscal years 1988-89 and 1989-90) was approved to allow the IJC to begin the most comprehensive study of Great Lakes water levels ever undertaken. The multiyear study results from the high water level crises of 1985-86. The project management team presented its progress report (Phase I report) to the IJC in July 1989. In February 1990, the IJC issued a directive to the team requiring completion of Phase II by September 1, 1991. Of significant note is the extent to which the public is being consulted during the study.

Information:
United States Transboundaries Division
External Affairs Canada
(613) 990-6912

17. POTENTIAL INTERJURISDICTIONAL WATER CONFLICTS WITHIN CANADA

With numerous rivers crossing provincial boundaries, competing uses in various jurisdictions can lead to conflict. Such disputes can always be resolved in the courts, but the implications of legal decisions can reach beyond the issue at hand and can be detrimental to future co-operative management of shared resources. Recognizing this possible impediment to the legitimate development of shared resources, the federal government seeks to develop a mechanism whereby interjurisdictional disputes can be addressed with a minimum of confrontation.

17.1 that interjurisdictional water resource problems arising from pollution or regulation of waterways be solved, where possible, by agreements between the jurisdictions concerned

The PPWB's Prairie Provinces Master Agreement on apportionment, signed in 1969 by the federal government and the three Prairie provinces, is a good example of interjurisdictional co-operation. The Board ensures the equitable apportionment of eastward-flowing streams among the provinces, monitors water quality problems and recommends appropriate management procedures to the provincial and federal governments.

The federal government, through DOE, DIAND, DOT, the Yukon territorial government, the GNWT and the provinces of British Columbia, Alberta and Saskatchewan is negotiating a master agreement for the management of the Mackenzie River basin. The agreement will address issues related to information exchange, sustainable resource use and development, and dispute resolution.

Other examples of major interjurisdictional co-operation include the GLWQA and the supporting Canada/Ontario agreement, the regulatory activities in the Ottawa River and Lake of the Woods and activities in support of the pollution control and regulatory boards of the IJC. (See II.16.5.) In the context of heritage canals, management of water levels, wetlands and recreational use is accomplished through co-operative agreements such as the Canada, Ontario, Rideau, Trent, Severn Agreement.

The CCME met at the Globe '90 sustainable development conference in March 1990 and adopted a Statement on Interjurisdictional Co-operation on Environmental Matters. The statement emphasizes that governments must work together and share responsibility for the protection and enhancement of the environment. It provides a framework for facilitating co-operation on environmental issues through the establishment of formal environmental agreements, information sharing and improved linkages between domestic and international activities.

Ministers announced a commitment to develop a national regulatory strategy for controlling water pollution from pulp and paper mills across Canada. They instructed their officials to finalize, on a priority basis, an approach to establish nationally consistent water pollution control standards for the industry and to allow for co-ordinated monitoring and enforcement procedures to minimize duplication.

Ministers also adopted the Canadian Memorandum of Understanding on Environmental Emergencies as a means of facilitating the sharing of resources and expertise during environmental emergencies.

17.2 that steps be taken to develop appropriate procedures so that in cases where the jurisdictions involved have tried but failed to reach agreement, and where the issue has become a major concern to one or more of the jurisdictions, those disputes can be referred to mediation or arbitration

The federal government is considering the strengthening of the water legislative base which will address, amongst other things, the issue of a dispute resolution mechanism.

17.3 **to negotiate with the provinces the development of a mechanism which would allow for the ultimate resolution of interjurisdictional disputes in cases where all other means of reaching agreement have failed**

The issue of interjurisdictional disputes has not been resolved. However, the CCME's Water Advisory Committee is drafting general principles for water management which, if accepted by governments, should, while subject to individual interpretation, contribute to a more co-ordinated approach to water management in Canada.

Information:
Water Planning and Management Branch
Inland Waters Directorate
Environment Canada
(819) 997-2071

18. INTERNATIONAL WATER RELATIONS

Canada's water is an interdependent part of a finite global water system. Consequently, the quality and quantity of Canada's water depend, to some extent, upon international efforts to minimize environmental degradation.

The objectives of the federal government's international water management activities are to maximize the potential economic benefit to Canadians by encouraging international, multilateral and bilateral collaboration in the development of water management knowledge and technology; to provide humanitarian assistance in alleviating water problems; and to encourage the reduction of environmental damage to the biosphere.

18.1 support for the United Nations and other multilateral institutions active in international water research, water management and related environmental fields

DOE continues to be active in major water programs of multilateral organizations such as the World Meteorological Organization's (WMO) Hydrology and Water Resources Program and the United Nations Educational, Scientific and Cultural Organization's International Hydrology Program, which promote scientific and technical exchange and development between member countries. Canada currently provides two rapporteur positions for WMO's Commission on Hydrology (for Network Design and Water Quality) and chairs the Regional Association IV Working Group on Hydrology. Involvement in the non-governmental International Association of Hydrological Sciences allows for information exchange and the promotion of co-operation in hydrologic research. DOE's NWRI manages the United Nations Environment Programme (UNEP)/World Health Organization (WHO) global water monitoring data base [Global Environmental Monitoring System (GEMS)] and is playing a major role in the current reassessment and modification of the GEMS/WATER program. Health and Welfare Canada is active in the revision of the WHO's guidelines for drinking water through provision of documentation, review of documents provided and participation in working group meetings.

18.2 encouragement of international efforts to reduce global environmental degradation

In June 1988, Canada hosted the Conference on the Changing Atmosphere, which dealt with the effects of climate change. This was the first meeting of its kind between environmental specialists and senior level policy makers. Canadian officials also participate in a number of working groups of the Intergovernmental Panel on Climate Change of the WMO and UNEP. International experts from the Working Group on Water Resources proposed a number of recommendations for action on aquatic resource policies and research as an anticipatory response to global warming.

As of July 1986, all new Canadian International Development Agency (CIDA) bilateral assistance projects (which account for about 40 percent of all CIDA disbursements) have been screened to ensure that their potential effects on the environment are considered and addressed. Many of CIDA's bilateral projects relate to environmental protection in areas such as forestry and reforestation, soil conservation and land management, improvement of drinking water, and the combating of industrial air pollution.

18.3 provision of training and of humanitarian, economic, scientific and technical assistance to other countries in the management of water quality and quantity

From 1968 to 1987, Canada provided approximately $1.7 billion in development assistance for water-sector projects through its bilateral aid programs in Asia, Africa, Central and South America, and the Caribbean. Of this total, roughly $630 million was devoted to hydroelectric projects, $400 million to irrigation and drainage, and $700 million to general water projects. A key objective of assistance in the latter category is the provision of reliable supplies of clean water, proper sanitation facilities and hygiene promotion.

Funding of water management programs in developing countries through CIDA is estimated to total approximately $21 million per year. CIDA also co-operates with agencies such as the United Nations Children's Fund and the WHO and with NGOs such as the Canadian University Services Overseas and CARE Canada on their water supply projects.

The International Development Research Centre (IDRC), an independent body funded by the Canadian government, is active in water management research for the developing world. For example, IDRC has worked with scientists and planners in Malaysia to adapt a computer package on water quality management developed by DOE's National Water Research Institute. IDRC has also helped develop simplified water quality testing methods for use in Asia and Latin America.

18.4 **prudent involvement in bilateral agreements that support the exchange of scientific knowledge and expertise and the export of Canadian industrial and technological products**

DIAND is active in developing the Canada/USSR Arctic Science Exchange Program, which will include joint water resources research. Various departments are participating in a Finnish initiative on the protection of the arctic environment. DOE's NWRI is the Canadian lead organization identified in an M.O.U. on scientific co-operation in the area of water ecosystem research that was recently signed between Canada and the USSR. NWRI is also involved in collaborative research projects under an M.O.U. with the Federal Republic of Germany. An interest in collaborative research is also being followed up with both France and the Netherlands.

Information:
Program Analysis and Coordination Branch
Inland Waters Directorate
Environment Canada
(819) 997-3820

19. DROUGHT

Drought is relatively rare in much of Canada. In the semi-arid climate of southern Alberta and Saskatchewan, the realities of drought are never far away. This climatically sensitive region requires a sound plan of action if the water needs for such major users as agriculture, industry and recreation are to be sustained. The federal government has stated its commitment to support the Prairie provinces in drought management initiatives.

19.1 encourage and promote water demand management approaches and conservation technology with a view to extending the use of limited supplies *(see also II.7.1 and II.19.3)*

PFRA Rural Water Development programs and larger multi-use storage projects provide water to sustain and enhance agricultural production and infrastructure while providing waterfowl habitat enhancement. Current activities under the Saskatchewan Irrigation Based Economic Development Agreement include planning for the rehabilitation and upgrading of the Southwest Saskatchewan Irrigation Projects. The objective is to assess this PFRA program with a view to making more effective use of available water through improved management practices and/or development of additional storage capacity for irrigation and other uses.

PFRA continues to discuss with the Prairie provincial governments a comprehensive federal/provincial approach to rural water development. The objective is to have co-ordinated programs that contribute significantly to drought-proofing the Prairie agricultural economy.

In December 1988, DOE produced a fact sheet on prairie droughts.

19.2 undertake, support and promote research into improving understanding of drought *(see also II.22.1)*

A considerable amount of work directed to understanding drought and developing mitigative measures has been undertaken at DOE's NHRI. A recent review of drought prediction methodologies and a study of the atmospheric circulation anomalies have provided insights into the possible causes of prairie drought. Some of these ideas are being explored further in collaboration with the University of Saskatchewan. Studies of the statistical properties of meteorological drought events in the South Saskatchewan River basin have also been undertaken to supplement work already carried out by DOE on the recurrence of low flows in the South Saskatchewan River. Other work is directed at improving the ability to monitor streamflow and soil moisture through the use of remote sensing data; assessing the effectiveness of procedures for retaining snow and snowmelt waters on farmlands; and improving understanding of droughts through studies of wetland hydrology, fractured till and technology transfer.

PFRA produces comprehensive water supply condition reports and current briefings on drought potential for the Prairie provinces on an ongoing basis. The application of new technologies for monitoring drought and co-ordinating activities between agencies involved in research, response planning and program delivery is being actively pursued.

The Saskatchewan Research Council, with funding from DOA and DOE, is studying the impact of the 1988 drought.

19.3 encourage the development and dissemination of water conservation technologies and practices to promote the best use of current supplies *(see also II.9.1 and II.19.1)*

EMR's Canada Centre for Remote Sensing has initiated a project to estimate soil moisture and snow water equivalent from radar remote sensing imagery. The algorithms developed will allow for a more accurate estimation of available water supplies. Study sites are located in Ottawa, Sherbrooke and Outlook. Discussions are under way for implementing projects in New Brunswick. The first phase of the project is expected to be completed in 1991.

A guidebook to water conservation in the home is being produced in co-operation with a number of

provinces. An inventory of watersaving devices for the home is being prepared. A pilot project is being developed (for DOE's Canada Centre for Inland Waters) with a view to making DOE facilities and, ultimately, all federal facilities more water efficient.

19.4 **encourage an integrated approach to planning and managing the augmentation and allocation of water supplies *(see also II.19.1)***

DOA's PFRA and DOE note a number of activities such as participation in various study boards and committees (e.g. South Saskatchewan River Basin Study, PPWB) as contributions to integrated planning and management.

Two separate drought strategies are being prepared by these departments in co-operation with other federal and provincial agencies. PFRA's Federal Drought and Disaster Response is aimed primarily at agricultural interests. Many of the recommendations in this strategy paper are being adopted. DOE's Drought Strategy Paper addresses water supply in general and highlights the need for an integrated delivery of data and information between all federal and provincial interests with a view to more effective drought forecasting and monitoring.

Information:
Western and Northern Region
Inland Waters Directorate
Environment Canada
(306) 780-5320

20. FLOODING

Many Canadian communities are located along the banks of rivers or lakes because of accessibility to water supply, recreation, transportation, level land for building, fertile land for crops and a pleasant view. The advantages of building on flood plains are sometimes offset by the risk of flooding. Significant levels of federal assistance in the form of flood control works and disaster assistance are occasionally required in response to epic floods in certain areas of the country.

Since the widespread flooding of the 1970s, a new approach has been taken to reduce damages from flooding. Under the auspices of federal/provincial/territorial bilateral agreements, flood-risk areas are identified and designated, and further vulnerable developments in those areas are discouraged. Where warranted, flood protection works may still be constructed to protect existing developments.

20.1 co-operate with the provinces and territories in compiling appropriate data that will make it possible to identify areas of flood risk and discourage inappropriate development in those areas

The FDR Program was introduced by DOE in 1975 to oversee the new federal approach to flooding. FDR agreements are in place with all provinces except PEI, where flooding is not a problem. An agreement has been signed with the NWT and negotiations are under way with the Yukon government. An agreement also exists between DOE and DIAND to identify flood-prone areas on Indian reserves.

Work continues on the main component of the program – mapping and designating flood risk areas.* By 1990, co-operative activities with the provinces and territories had resulted in the designation of more than 150 sites across Canada. As the FDR Program nears completion in each of the provinces/territories, development of federal/provincial "maintenance agreements" is under consideration. The first is expected to be signed with Nova Scotia in the near future. Topics to be examined include long-term approaches to mapping and schedules for updates and financing.

In flood risk areas where existing development cannot be moved or where flood control works such as diking and dams are not economically feasible, the federal government, in conjunction with the provinces/territories, can jointly establish flood forecasting systems to provide residents with early warning of an impending flood. Federal involvement, however, is limited to basins/rivers of high national interest. Flood forecasting agreements exist with Manitoba and New Brunswick, and there is a proposal for an agreement with the Northwest Territories. Federal involvement is primarily restricted to the initial stages of development by providing funds for studies and the establishment of forecasting centres. Once this is accomplished, the provinces are responsible for maintaining the established network.

A typical example of federal/provincial co-operation in FDR work is the EMR/New Brunswick Department of Environment joint flood mapping of the Saint John River using synthetic aperture radar imagery. The method will be tested on other rivers which experience flooding. Project completion is expected by 1990.

* Designated Area: flood-prone area to which the provincial and federal governments agree to apply their flood damage reduction policies by refusing to undertake, financially support or provide flood damage compensation for new development after a specified date.

20.2 **provide the public with information on floods, federal policies and programs and on the susceptibility of specific areas to flooding**

Under the FDR Program, provisions are made to supply information to other government agencies, the private sector and the public on floods, federal water policy and programs. For example, Public Information Flood Risk Maps are distributed as areas become designated. National and regional publications and videos relating to flooding and the FDR Program are also produced. Emergency Preparedness Canada sponsors regular presentations by the Department of the Environment to mayors and elected officials on the FDR Program (see also II.21.1 concerning the Great Lakes Water Levels Communications Centre).

20.3 **after designation, neither support nor provide disaster assistance coverage to new flood-vulnerable development**

Under the terms of the FDR Program, both the federal and provincial governments continue to discourage flood-vulnerable development through a variety of financial levers in their many funding agencies. These policies remain in force for a period of five years following the completion of flood risk mapping and may be further extended by mutual consent.

20.4 **consider contributing to flood-control works to protect existing development where federal interests are threatened or where flood damages are likely to have significant national implications**

The federal government continues to contribute to flood control works to protect existing developments throughout Canada. Examples include the Mille Iles control structure in Quebec, the Red River ring dikes in Manitoba and the Fraser River dikes in British Columbia, where work will continue until March 31, 1995. Negotiations are also under way in Newfoundland to provide protective works for the flood plain area of the town of Placentia.

20.5 **provide for assessment of the effectiveness of various flood-protection alternatives taking into account costs, benefits and environmental impacts, and encouraging the best combination of alternatives for an agreed level of protection**

Federal/provincial technical review committees are regularly involved in this type of assessment. For example, DOE, DOA and the Township of Mersea completed a study in 1988 of long-term solutions to the erosion and flood control problems at Point Pelee National Park. Prior to the study, the provincial and federal governments and ratepayers invested $1.04 million for dike protection works to protect farmland along Lake Erie close to Point Pelee National Park.

20.6 **encourage assessments of the environmental impact and social implications of large flood control structures**

Within DOE, plans are being formulated to ensure that the EARP is applied to FDR structures as part of the overall assessment process (see II.11.4).

Information:
Water Planning and Management Branch
Inland Waters Directorate
Environment Canada
(819) 997-1783

21. SHORELINE EROSION

Erosion occurs along the shores of oceans, lakes, rivers and canals and is caused by wind, moving water, ice or wave action from commercial shipping. The federal government bears no responsibility for, and cannot regulate, natural erosion. Accordingly, it will not undertake or participate in remedial activities in this regard. It supports the concept of discouraging settlement and investment in areas subject to natural erosion.

21.1 participate in programs intended to delineate areas subject to a serious erosion hazard where there is a significant national interest

Under the Canada/Ontario Flood Damage Reduction Program, the federal and provincial governments, in co-operation with local conservation authorities, are mapping the Great Lakes shoreline and defining flood and shore erosion hazard areas so that these hazard areas will never be used for building sites. Information on erosion hazards is being incorporated into a Geographic Information System for the entire Great Lakes shoreline.

DOE is acting on the recommendations of the October 1988 IJC Interim Report on the high Great Lakes levels issue of 1985-86. The report on Phase I of the IJC's Reference on Great Lakes high water levels was released in August 1989. A new study board was set up in February 1990 to begin work on Phase II of the reference. DOE maintains the Great Lakes Water Levels Communications Centre in Burlington; supports public awareness activities aimed at the Great Lakes water levels issues, including shore erosion; and is proposing coastal processes research on the relationship between fluctuating water levels and shoreline erosion on the Great Lakes.

21.2 consider undertaking remedial measures in certain cases where erosion damage has been caused by wave action from commercial shipping or by the existence of a federal structure in the waterway, or in cases where federal facilities or lands are subject to damage

For a number of years, the federal government has contributed to the cost of protective works for shoreline properties being eroded as a result of wave action from commercial navigation or the presence of Transport Canada-owned structures. The program is currently administered by the Canadian Coast Guard. To be eligible for shore protection under the program, a recommendation regarding cause and technical justification of the erosion is normally obtained from Public Works Canada, which provides Transport Canada with engineering expertise.

Information:
National Water Research Institute
Environment Canada
(416) 336-4913

22. CLIMATE CHANGE

Climate change is becoming a topic of increasing importance and public awareness. The amounts of certain heat-absorbing gases in the earth's atmosphere are increasing as a result of various human activities, in particular, the burning of fossil fuels. These changes are expected to cause enhanced atmospheric warming of the earth's surface and a rise in mean global temperature. Since hydrological processes are integrally related to the atmospheric system, any change in climatic conditions will ultimately affect the supply and demand for water. This has implications for the design and management of water resource projects.

22.1 Improve the availability and interpretation of climate data and services

DOE's Canadian Climate Centre (CCC) continues to provide advice and consultation in support of hydrological operations and water resource management by monitoring moisture conditions nationally and preparing weekly water budget components and moisture indices.

The CCC is participating in a WMO intercomparison of solid precipitation measurements by operating six research sites in support of a five-year experiment aimed at assessing the accuracy and compatibility of solid precipitation measurements.

DOA has developed and implemented regional and national real-time computerized systems to monitor crop soil moisture conditions and predict the extent and severity of drought and other weather hazards, including frost and excess moisture. These systems produce reports throughout the growing season.

22.2 make effective use of climatological information in water resource planning and management

DOE routinely uses climatological information in hydrologic modelling and forecasting activities. Water resources personnel encourage the awareness and consideration among water specialists of appropriate climate change scenarios, particularly for purposes of medium- to long-term planning activities.

Climatological information has been used by DOA in various modelling activities including estimating crop yields, improving irrigation scheduling, estimating winter soil temperature extremes as a means of predicting or assessing overwinter crop survival and predicting the extent and severity of radiative frosts. Marketable software has been made available for IBM-PC-compatible computers for irrigation scheduling. In co-operation with CIDA and the Brazilian government, DOA has calibrated soil moisture estimation models for use in monitoring and evaluating moisture conditions in Brazil as part of an ongoing Canada/Brazil program to transfer existing Canadian technology to a Third World country.

22.3 conduct further research on the relationship between climate and water resources

Projects in DOE supported by the Canadian Climate Program (CCP) included the evaluation of the HYDROTEL model for operational use of remotely sensed data in hydrological models; the development of objective analysis methods for the provision of integrated information from satellite, radar and gauge data; the development of software to estimate regional evapotranspiration using integrated satellite data; and the development of algorithms for the determination of snow water equivalent using passive microwave data.

Since 1987, DOE's CCC has undertaken research on the relationship between climate and water resources through its studies on freeze/thaw of soils and transport modelling.

DOE's NWRI has been conducting research on the effects of climate on heat storage and distribution in the Great Lakes. In collaboration with the multi-agency Canadian Institute for Research in Atmospheric Chemistry, NWRI is investigating the role of the Hudson Bay lowlands in the methane balance of the atmosphere.

In co-operation with NASA (FIFE Project), DOA is carrying out large-scale measurements of CO_2 and water vapour using aircraft-mounted instrumentation. The experiments are providing input data for Global Circulation Models and are improving the understanding of the global carbon balance and water use by plants.

22.4 conduct further research on the impact of climate change and variability on water resources

Studies conducted under the CCP have assessed the possible impacts of climatic change on navigation and power generation in the Great Lakes, sea level rise in Atlantic Canada, and hydroelectric generation in the James Bay region. Summary reports on these studies were published through the Climate Change Digest series. The performance of selected Global Circulation Models in reproducing the climate of Canada was assessed. Interim studies of the feasibility of using palaeoclimatological data to extend drought-time series were undertaken.

DOE's CWS completed a national ecoclimatic map and report and developed a model to predict the impacts of climate change on Canadian ecosystems.

DOE completed a report on the implications of climate change for water resources in Atlantic Canada and initiated a joint project with New Brunswick to assess the impact of climate variability on the water resources. CWS also conducts annual reporting on prairie potholes (May and July), water availability, precipitation and waterfowl production ("Prairie Canada Habitat Report" for Flyway Waterfowl Technical Committee) in support of the development of longer-term climate change indices.

DOA has undertaken a study to investigate the potential implications of climate change (including moisture in the growing season) for agriculture in the Yukon and for the forestry and agriculture sectors in Quebec.

DIAND, through the Northwest Territories and Yukon Climate Advisory Committees, identified climate data and research needs and priorities. Studies were conducted on the effects of climate change on northern resources. In 1989, work focused on climate impacts on the Mackenzie River.

Results of Canada's contribution to an IIASA/UNEP climate impacts study to determine the implications of climate change and variability in cold margin countries were released. Canada participated in the study along with the USSR, Japan, Finland and Iceland. The Canadian component focused on Saskatchewan and was a joint effort between DOA, DOE and the Saskatchewan Research Council.

Information:
Canadian Climate Centre
Atmospheric Environment Service
Environment Canada
(416) 739-4433

23. WATER DATA AND INFORMATION NEEDS

Under its constitutional responsibilities relating to census and statistics, the federal government is required to make available a basic level of data and information on Canada's water resources. Basic hydrological, meteorological and socio-economic data have become important tools to enable managers to understand past and present water resource-related conditions and to anticipate future needs, particularly as they relate to the transportation, hydroelectric power, fisheries and agricultural sectors. There is, therefore, a need for reliable and cost-effective data-gathering systems.

The federal government is committed to maintaining co-operative data programs with the provinces and territories in the interest of understanding and managing the resource for the common good.

23.1 work with the provinces and territories to produce reliable and timely data and information on the quantity, quality and variability of the nation's water resources

DOE programs for the systematic collection and compilation of data on streamflow, water levels, sediment transport, water quality, and related information on glaciers, snow and ice continue to operate in support of water management basin studies and implementation programs and to provide essential information to a variety of water users. A more recent innovation is the collection of background data on water use by municipal and industrial users in Canada.

The collecting, processing, storing and publishing of data from hydrometric and sediment stations in accordance with federal/provincial agreements established with all provinces and territories continues, albeit under resource constraints, particularly as concerns monitoring north of 60°. Progress has been made in the development of improved capabilities for the analysis and interpretation of these data and for the planning, design and evaluation of the data collection networks. Achievements include completion of a low-flow analysis program, development of software for network analysis, development of methods for mapping and displaying national hydrometric network and runoff conditions, a national federal/provincial network planning workshop, and the development of a national inventory of hydrometric station characteristics, uses and network maps. The sediment program provides essential information on sediment-borne contaminants, silt and bedload transport used for hydroelectric studies, developments, and fish and bird habitat research.

Water quality monitoring agreements, now signed with six provinces, provide for consistent and co-operative collection, analysis and storage of water quality data and information across Canada. Under the terms of the agreements, networks of fixed stations and recurrent stations are monitored through cost- or work-shared arrangements. Both parties have access to the data collected and can produce joint reports (see II.2.1).

Quality assurance is of great concern in the context of these agreements. At DOE's NWRI, activities in support of water data collection include programs of quality assurance in support of these federal/provincial agreements; the Upper Great Lakes Connecting Channel Programs; the Great Lakes Water Quality Surveillance Program; the PPWB; and the Long Range Transport of Airborne Pollutants (LRTAP) program. Other ongoing data support activities include analytical methods adaptation for the water quality

program and current meter calibration for the water quantity program.

Through the GSC (Exploration Geochemistry), EMR has worked with the provinces through its water analysis programs, designed originally to assist the mineral exploration industry. For example, chemical data (twenty years) have been compiled for waters from lakes, streams and some wells under federal, federal/provincial and provincially funded geochemical surveys throughout the Cordillera and from the southern Canadian Shield Boreal forest terrain to the tundra of Baffin Island. Individual surveys are regional in scale (greater than 10,000 km^2) and density (usually one sample per 13 km^2) for a total area coverage of almost 2 million km^2 from about 150,000 sample sites.

23.2 encourage the extension of data programs into the North and generally remote areas

A five-year program to develop, purchase and install 350 DCPs at remote sites in Canada was completed by DOE. The implementing of a hydrological and meteorological network in the Mackenzie River basin is a priority.

As noted in II.23.1, increasing operational costs have the potential to seriously erode hydrometric networks in the North. Although hydrometric expansion agreements have been developed, they have not been implemented because of funding constraints. The Canada-Yukon network may have to be reduced by twenty-five stations or one-third of the network by 1991-92 if new resources are not secured.

The two water quality agreements that were negotiated by DOE, DIAND and the territorial governments have also not been implemented because of funding constraints.

23.3 maintain and promote the use of a range of national water data-bases, as well as a comprehensive directory of water-related data and sources of such data and information

A directory, called DREF, of environmental data bases is being updated for online access through CAN/OLE at CISTI (Canadian Institute for Scientific and Technical Information) with the full co-operation of provincial water agencies.

DOE is continually expanding and enhancing the National Water Quality Data Base, NAQUADAT. It now includes data for co-operative multi-agency ventures such as the National Acid Rain Monitoring Network, the Federal-Provincial Acid Rain Monitoring Network and Federal-Provincial Agreements on Water Quality Monitoring. Data from DOE's on-going programs are also stored in NAQUADAT and are available to the public. The data base is being upgraded consistent with developments in data base management systems. This will allow easier and more efficient data retrievals by all users. Periodically data are published in report format.

DOE maintains the National Hydrometric Data Bank (HYDAT) and continues to disseminate streamflow, water level and sediment data to users. A communications plan aimed at both the professional user and the general public has recently been developed and implemented. A presentation kit for regional use has been prepared; it concerns the potential role of new technology in hydrometric-related activities. Hydrologic methods and the benefits and use of hydrometric data and information products were topics for data-user workshops in February 1989.

23.4 encourage the integrated planning of information-gathering systems

To encourage the integrated planning of information-gathering systems, the planning of long-term quality index stations was pursued by DOE. Several meetings were held between DOE's quality and quantity data collection branches to discuss planning requirements, and network assessments have been undertaken for integrated planning purposes. Joint mapping of index stations is in progress. Water balances for LRTAP test basins have been prepared.

DOE Services are working jointly to identify streamflow and meteorological data requirements for international flood forecasting. An inventory of stations and maps was prepared, U.S. Weather Service information was obtained and draft technical papers were prepared for presentation at the CWRA meeting in 1989.

A national federal/provincial network planning workshop was held in Winnipeg, October 19-20, 1989. An evaluation of the New Brunswick hydrometric network was completed using an innovative station audit methodology which integrated engineering, economic and user needs objectives.

DOE is preparing to host a federal/provincial/territorial workshop in 1990 for purposes of modernizing and establishing compatibility between all Canadian ground-water data bases.

Through a Memorandum of Understanding on State of the Environment (SOE) reporting, DOE is interacting with Statistics Canada (which has primary responsibility) in the building and maintenance of an SOE Information System (SOEIS). SOEIS, presently in the development stage, will provide environmental and socio-economic data.

23.5 augment certain data holdings on, for example, water use, water pricing or ground water, when they are needed to deal with new issues ***(see also II.3.1)***

An industrial water use survey for 1986 was undertaken by DOE through fiscal years 1987-89. A report will be published in 1990. A survey of municipal water use and water prices has been completed and reports will be issued in 1990-91.

23.6 undertake and promote new technology appropriate for general use across Canada

The DCP program noted in II.23.2 is a significant DOE effort to remain at the forefront of data collection technological development. Compact disc technology for data storage and retrieval has been installed, and CD-ROMs are now in trial use in the Regions with hydrometric agreement co-operators and with other federal agencies. DOE has also developed a hydrometric data base on an optical disk and is evaluating it as a new data dissemination product. Interactive software is being developed to enable users to perform various hydrologic analyses from the disk.

A real-time data communications system has been established by DOE. Direct readout ground receive stations are semi-operational at Downsview, Vancouver and Gatineau.

A prototype expert system, "Raison" (Regional Analysis by Intelligent System on a Microcomputer), was developed by DOE's NWRI to manage data records related to acid rain. The system provides a framework for evaluating various environmental problems and includes data sets for most provinces.

Up-to-date data-collection technologies are fundamental to DOE's water quality program. Research has led to developments such as the use of liquid-liquid and liquid-resin extractors to sample ultra-low levels of contaminants in the aquatic environment. An all-weather precipitation sampler suitable for measuring organic contamination in rain and snow is being developed. A prototype is now being tested under field conditions prior to its use in a network across Canada to measure the extent of toxic rain.

23.7 implement cost-recovery policies for data and information, recognizing that basic data constitute a common good

A Cost Recovery Guide directed at DOE's water data and information programs, expertise and use of facilities was published in April 1988 and is now being implemented. It defines the level of basic or core services to be provided to the Canadian public out of general tax revenues and what constitutes special services for which some portion or all of the costs will be recovered.

Information:
Water Resources Branch (Water Quantity)
(819) 997-1508
Water Quality Branch
(819) 997-1920
Inland Waters Directorate
Environment Canada

24. RESEARCH LEADERSHIP

The federal government recognizes its leadership role in the development of the knowledge base to support sound water management. The far-reaching implications of issues such as climate change, acid rain and toxic contamination of rivers, lakes and ground water are confronting researchers with the challenge of understanding the complex interrelationships of biological, physical and chemical components of aquatic ecosystems.

The federal government is firmly committed to sustainable development, and federal scientists will continue to contribute to the pure and applied research necessary for more efficient and nonpolluting use of water and associated resources.

Several federal departments have strong research programs in support of national and global water management. DOE has two multidisciplinary research institutes that study a range of priority water issues: NWRI and NHRI. The Freshwater Research Institute of DFO contributes to ecotoxicological studies of fish, and NHW conducts research into the human health aspects of polluted water in support of national drinking water standards. Agriculture Canada's research scientists address the effects of agro-chemicals and irrigation on water resources and EMR supports technological development in support of fossil fuel and mineral extraction and hydroelectric development that is less polluting and environmentally disruptive.

24.1 providing leadership in water research directed to supporting national and significant regional requirements

The federal government provides leadership in water research in a variety of ways, such as by participating in multilateral research priority-setting organizations, by organizing workshops and symposia to outline research needs for emerging water issues, and by allocating funds to non-government scientists addressing priority issues. Furthermore, by conducting and communicating its own internationally recognized research (outlined in II.24.3), the federal government provides direction and sets a standard within the Canadian water research community.

Cleaning up the Great Lakes has been a national priority for two decades, and federal agencies continue to work with Quebec, Ontario and the U.S. in steering the research agenda in support of this priority. Scientists from NWRI have drafted the research programs needed to implement the revised Great Lakes Water Quality Agreement. Their role in leading this research includes chairmanship of the Council of Great Lakes Research Managers, participation in the IJC's Science Advisory Boards and more than twenty other IJC working committees, and development of research strategies for the Remedial Action Plans for Hamilton Harbour and other IJC Areas of Concern in Canada.

NWRI and NHRI have organized several symposia, workshops and conferences, both nationally and internationally, on a number of critical water problems. These include toxic chemical effects in the St. Lawrence River, trace metal contamination, drought, ground-water contamination, acid and toxic rain, ecotoxicological assessments of

contamination and the priority chemicals identified in CEPA.

As mentioned earlier (II.7.3), DOE and Quebec have developed a plan of action to protect and restore the St. Lawrence River in partnership with industry and universities.

The conservation of water, both quantity and quality, is an essential component of a sustainable agricultural system. Agriculture Canada's Research Branch is responding to these issues through the Great Lakes Water Quality Initiatives, the Canada/Ontario Soil and Water Conservation Program and additional research consistent with the departmental thrust in the conservation of our natural resources. A national strategy for reducing pesticides in ground water was launched by DOA Pesticides Directorate in 1989.

The Natural Science and Engineering Research Council (NSERC) is Canada's largest single funding organization for university research. Federal departments work directly with NSERC to help it identify the priority areas for water research in Canada. The objective is to enable universities to contribute effectively to pure and applied water research as well as to train future Canadian water scientists.

DIAND initiated the Northern Water Studies Program in 1988 to advance the knowledge of northern water science, to aid in regulatory decision making and to assist in water policy analysis. The program has provided $410K for over forty projects in the Yukon and NWT.

Recently DOE has made a concerted effort to disseminate more widely the objectives and outcomes of its research program. Beyond the realm of scientific journals and conferences, DOE's research institutes now make use of a variety of media, including newsletters, fact sheets, annual reports, seminars and open house events to encourage discussion and evaluation of national research issues.

24.2 establishing research advisory mechanisms, with broad representation from the research clientele, to advise on research needs and priorities

The establishment of Research Advisory Boards for NWRI and NHRI is currently under consideration. Such boards would have representatives from universities, provinces, industry and non-governmental groups, and would provide advice to the Institutes on the science needs of emerging water issues. Currently NHRI's research agenda is partially guided by the Western Research Advisory Committee, which facilitates communication between operational program managers within DOE and scientists at NHRI.

DOA has in place research advisory mechanisms, such as Station Advisory Committees and the Research Branch Advisory Committee, with broad representation from provincial governments, universities and industries. These committees provide extensive input into research needs and priorities. DOA also conducts regular reviews of its research programs.

24.3 conducting targeted basic research, applied research and experimental development directed to current and emerging water issues important to the federal government *(see also Part II, sections 2, 23 and 25)*

NWRI and NHRI have the largest federal water research programs, totalling 328 person years with a research budget of $24 million. Scientists work in multidisciplinary teams carrying out priority research in the full range of aquatic sciences to improve understanding of the capacity of aquatic ecosystems to sustain economic development. Priority issues at NWRI include the fate and effect of toxic chemicals (including pesticides), lake restoration technology, ground-water contamination, acid rain, exchange of pollutants between air and water, analytical methods for monitoring chemicals, modelling to understand aquatic processes and to evaluate the effectiveness of pollution control strategies, biomonitoring techniques, hydrodynamics of sediment transport, and wave forecasting and wave climate prediction models. NHRI also has a ground-water research program as well as other research teams that address the effects of human activity on the aquatic environment of the Prairies and the North. Another significant part of the research program of NHRI is developing a better understanding and modelling capability of the hydrological cycle, particularly evaporation and transpiration factors. This

is fundamental to understanding the effects of climate change on the availability and distribution of water. Other elements in NHRI's climate research program include collecting and analysing climate change data over the last 300 years and developing remote sensing techniques for hydrological research and monitoring.

DOA conducts research on the environmental impacts of pesticides on surface and ground water. In some cases the work is carried out co-operatively with DOE, such as an NWRI research study on pesticides in farm dugouts. A report identifying leachable pesticides and areas vulnerable to ground-water contamination across Canada was published. This report is the first step in the targeting of research/monitoring/investigation programs. Data derived from these programs will be used to develop appropriate regulatory responses. The development of a co-operative national strategy on pesticides in ground water is currently being discussed with DOE. An agreement is being negotiated to establish another joint DOA/DOE project on the effects of agricultural practices on soil erosion. DOA is in the process of establishing priorities with respect to research under the Great Lakes Water Quality Agreement in the area of nonpoint source pollution and contaminated sediments. Other DOA water-related research projects include determination of seasonal water quality on the upper Oldman River, management of soil over shallow water tables to optimize crop yield while minimizing ground-water pollution, determination of irrigation requirements for various vegetable crops and the use of satellites to measure water erosion. Furthermore, DOA is developing technologies aimed at minimizing contamination of water bodies by nitrogen. In co-operation with the Ontario government and industry, DOA is developing an improved soil test for nitrogen. In Prince Edward Island and New Brunswick, techniques are being developed by DOA to improve nitrogen retention in soils. In British Columbia, DOA is evaluating crops for their ability to use nitrate.

GSC of EMR is undertaking research studies in water chemistry (toxic elements) and modelling of ground-water movements. GSC is also carrying out research on relationships between geological/geochemical environments and certain human health problems. (See also Part II, sections 2.4 and 25.2.)

24.4 conducting and encouraging research on the value of water in its many uses

Under the National Water Use Analysis Program, DOE maintains an inventory of water-use data, which is integrated with its water quantity and quality data. This data base provides information for national and regional water-use trend analysis.

Early in the 1980s, DOE initiated a study on water supply constraints to energy development. The outcome, the Water Use Analysis Model (WUAM), is an analytical tool that allows managers to assess the socio-economic implications of alternative water conservation strategies. It can assess the implications of changes in water supply due either to external conditions such as climate variability or reallocation of water amongst users. The model is being adapted to suit a variety of geographical regions. The adaption for Quebec has been completed and is under way for the Prairies. Modifications for Ontario are just beginning. The model was developed in conjunction with a private consultant who will market it for various water management applications.

DOE has played a significant role in the CCME Municipal Water Infrastructure Financing Study. In Phase 1, which is nearing completion, municipal water use and pricing data were compiled.

DOA's research makes a significant contribution to more efficient water use, particularly through the development of crops less dependent on irrigation and technological improvements to irrigation.

As an initial step in defining the range of water management strategies that could promote more efficient water use, DOE has prepared a state-of-the-art review paper on water demand management. The paper assembles current knowledge and identifies research needs for analysing the effects of various demand management strategies on water use in three sectors, municipal, industrial and agriculture, and for nonwithdrawal use.

24.5 **regionalizing research efforts so that, when feasible, issues will be dealt with in the region in which they arise**

DOA has research stations across Canada. Research conducted at these stations in all areas, including water quality and quantity, is regionally oriented. Under the aegis of the National Soil Conservation Program, accords and agreements are signed with the provinces. Research projects will be undertaken after consultation with provincial governments and the industry.

To make effective use of its resources, DOE organized its institutes so that much of NHRI's activity concentrates on significant regional issues of concern to western Canada, while the majority of NWRI research deals with eastern regional problems. A good example is the ground-water research program. NHRI researchers tackle issues such as the effects of pesticides used extensively in the west and the impact of deep-well disposal of oil industry wastewater. NWRI's ground-water research examines industrial contamination in the Niagara frontier, aquifer restoration at the Gloucester landfill site near Ottawa and Ville Mercier, Quebec, and pesticide contamination in the Atlantic region.

NWRI established field research sites on Prince Edward Island to learn how aldicarb (a pesticide applied on potato fields) moves through the ground and what controls its degradation. The outcome was guidelines for the application of aldicarb, which will reduce the likelihood of contamination of rural drinking water wells.

In other cases, DOE makes use of specific scientific expertise available in one research institute to conduct research of a similar nature in different geographical locations. For example, lake restoration techniques are being developed by NWRI in both Alberta and Ontario. Oxygen injection technology to improve water quality has been tested in Hamilton Harbour and is undergoing evaluation in a western eutrophic lake in a co-operative study with the Alberta government. The same research team is also working jointly with private-sector researchers in Alberta to evaluate lime treatment of eutrophic farm dugouts that have previously been contaminated with copper sulphate algicide. One objective is to develop a method that would also be applicable to remediation of some of the areas of concern in the Great Lakes.

Collaborative research with either federal regional operational units or provincial water management agencies is another way of regionalizing research efforts. DOE has joint studies between its research institutes and regional monitoring or regulatory groups in the Great Lakes, St. Lawrence, and the Athabasca and Fraser rivers, amongst other regional projects. A federal/provincial initiative is under way between DOA and PEI on soil and water conservation. The work is aimed at appraising and developing conservation and management practices by evaluating soil drainage systems and erosion control measures.

24.6 **co-operating with and encouraging private-sector research efforts by supporting commercial access to government research facilities** ***(see also II.25)***

A program to promote private-sector use of the NWRI Hydraulics Laboratory on a cost-recovery basis has been established. NWRI has several unique water flumes, wave tanks and other equipment which are essential to its own research program but not always in use by federal scientists. The objective of the marketing program is to encourage private engineering and research companies to make use of this equipment. This is the only major effort to encourage commercial access to government water research facilities, but there are numerous examples of private-sector use of unique government equipment in joint government/industry research projects, many of which are carried out by DOE's Wastewater Technology Centre.

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National Hydrology Research Institute (DOE)
(306) 975-5751
Freshwater Institute (DFO)
(204) 983-5118

25. TECHNOLOGICAL NEEDS

As population and economic development grow, the demands on the water resource increase. A combination of new management strategies and innovative technology allows us to continue to benefit from the use of the resource and to have reasonable expectations as to its future well-being. The new environmental awareness, however, is requiring greater efforts in both of these areas. In response, the federal government is making progress in refining management tools such as demand management, enhanced legislation with enforcement mechanisms and the use of water quality objectives. Significant technological advancement will also have to be made by both the government and private sectors in key areas such as water-use efficiency, pollution control by mechanical, chemical and biological means, and in data management if long-term economical and environmental security is to be assured.

25.1 support research directed to technological development;

and

25.2 demonstrate national leadership by undertaking, supporting and promoting technological research, development and transfer *(see also II.2.4)*

NHW has continued its program of supporting drinking water treatment research in collaboration with the provinces, universities, and DOE. Current studies include the occurrence and significance of disinfection by-products and the treatment of water by granular or biologically activated carbon. A major study of biologically activated carbon started in 1988 and will continue until 1990.

In response to the National Agriculture Strategy signed by the federal and provincial ministers of agriculture in 1986, part 5, Proposal for Action, "Canadian agricultural research and technology transfer: Planning for the future" was published in 1988. The document establishes the principles and policies to guide technological development and transfer for Agriculture Canada, as well as other programs and activities affecting the agricultural sector. Specific examples of DOA research include its involvement in reclamation of saline land with mole drainage, hydrological techniques to assess irrigation efficiency, validation of the digital elevation model for watershed characterization in south coastal British Columbia, field irrigation studies to determine effects of pesticides in irrigation water and evaluation of new and conventional field sprayer systems.

As part of the St. Lawrence River Action Plan, DOE and ISTC manage a $37 million fund (DOE $17M, ISTC $20M) for the co-operative, five-year DOE/Quebec/private-sector St. Lawrence River Environmental Technology Development Program to reduce industrial pollution in the St. Lawrence River through the development of clean treatment technology.

An ISTC Environmental Industries Sector Initiative will assist the Canadian environment industry to capture a share of the domestic and international market for environmental products. The program, operational until 1992-93, has a water component and is aimed at developing sector and market intelligence.

Other significant activities include joint DOE/EMR/INRS-Eau development of hydrologic modelling techniques incorporating remotely sensed data and digital elevation modelling; DOE application of compact-disc technology to data management; advances in lake restoration technology through the use of oxygen injection (DOE/Alberta/University of Alberta); a DOE development to convert sewage sludge to oil which not only provides an economic return, but prevents pollution related to past disposal practices; and the development of an instrument to measure frazil ice in water, which is important to the hydroelectric industry. Canadian companies have acquired licences to commercialize the latter two technologies.

A number of processes are being developed in laboratory or in pilot-scale projects to assist municipal and industrial clients in reducing contaminants in their effluent in a cost-efficient manner. These include alternative technologies to reduce discharge of toxicants (i.e. iron cyanide) from gold mining and milling operations; a recovery process for solvents

from organic wastes of the paint industry; sludge disposal of pulp and paper wastes that will reduce the need for landfills which can result in groundwater contamination; and anaerobic technology to pretreat industrial wastewaters to reduce organic compounds.

Several new analytical methods to analyse low levels of contaminants in sediments, fish and water are under development in DOE. Contaminants include chlorinated phenols, dibenzo-p-dioxin, and anilines and chloranilines, all of which are associated with pulp mill effluent. A robotic system for automated contaminant analysis of a large number of water samples was developed by NWRI.

A high resolution gas chromatograph-mass spectrometer has been installed in the National Water Quality Laboratory for both routine monitoring and research analysis of low-level contaminants such as dioxin.

DOE has taken the initiative to form an independent, self-regulating association of environmental analytical laboratories. A first priority is to put in place a quality assurance program for chemical analysis. In the long run, the association will be useful for promoting technology transfer, particularly to small laboratories.

NWRI produces "reference materials" and "certified reference materials" to assist laboratories in obtaining more reliable and compatible data for trace elements of toxic organic chemicals in sediments and water. These are now being marketed to government, university and private laboratories and will improve the quality of environmental monitoring programs.

DOE's NWRI has developed a marketing strategy to increase the use of its facilities by the private sector for technology development.

25.3 co-ordinate federal and provincial efforts through such forums as the Research and Development Co-ordination Committee of the Canadian Council of Resource and Environment Ministers

Research needs for Canadian Water Quality Guidelines were addressed in a report prepared for CCME (February 1989).

The Research Advisory Committee of the CCME is preparing, under a DOE lead, a data base of environmental research and development projects under way over the last three years. While the emphasis is on environmental protection research, the inventory will also include the broader aspects of research related to environmental management. Publication by CCME is expected in 1990.

25.4 facilitate the transfer of technology between Canada and other countries

Over the last several years, PFRA, under contract to CIDA, has provided significant technical advice and guidance in the area of water management in Egypt, Pakistan and Indonesia. This work has included training staff in Canada for duties in Indonesia.

DOE continues to manage the Canadian HOMS data base (part of the UN-affiliated World Meteorological Organization's Operational Hydrology Program), a framework for the documentation and implementation of operational hydrologic techniques around the world. In 1987-88, fifty-six requests for Canadian components (hydrologic techniques) were supplied to thirteen countries, while in 1988-89, forty requests were supplied to thirteen countries. Canada has over forty components in the data base.

Other DOE activities linked to technology transfer include the involvement in the WMO projects on real-time intercomparison of hydrologic models and intercomparison of hydrometric instrumentation; the provision of training in operational hydrology to scientists and engineers from various countries (e.g. specifications on hydrographic surveying equipment and related data analyses software were supplied to India and resulted in a subsequent sale of devices from a Canadian supplier); the adaption of an expert system for predicting the effects of acid rain to manage water quality data in Malaysia; and continued participation in the International Standards Organization.

A model developed by DOE to predict changes in river morphology and the resulting changes to the hydrologic regime (MOBED) has been

demonstrated in Bangladesh and Pakistan where it may be applied to flood forecasting, predicting sedimentation of shipping canals and assessing the effects of irrigation on rivers. The funding of the trip to demonstrate the technology was provided by CIDA.

Several simple and inexpensive microbiological potable water tests (including coliphage) have been developed and/or evaluated by DOE. The test kit has been demonstrated in Brazil, Chile, Egypt, Malaysia, Morocco, Peru, Singapore and Thailand and is undergoing final evaluation in a number of countries. Funding was provided by the International Development Research Council. Other ecotoxicological monitoring procedures have been demonstrated in Korea, Finland and Denmark. There are many examples of scientific exchanges to demonstrate new analytical methods with such countries as Korea, China and Germany. Bilateral agreements to promote Canadian pollution control technology have been entered into with agencies in several countries, including the U.S. EPA and the Swedish Water and Wastewater Association.

25.5 Implement appropriate technologies to meet federal responsibilities at federal facilities

The construction of the new Banff Sewage Treatment Plant designed by DOE's Wastewater Technology Centre is now completed. The plant will be operated by WTC to verify new technology related to automated process control.

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Technology Development and Technical
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APPENDIX A

ACRONYMS

BWT	Boundary Waters Treaty
CANMET	Canada Centre for Mineral and Energy Technology
CARE	Care Canada
CCC	Canadian Climate Centre
CCIW	Canada Centre for Inland Waters
CCME	Canadian Council of Ministers of the Environment
CCP	Canadian Climate Program
CEPA	*Canadian Environmental Protection Act*
CHRS	Canadian Heritage Rivers System
CIDA	Canadian International Development Agency
CPS	Canadian Parks Service
CUSO	Canadian Universities Services Overseas
CWA	*Canada Water Act*
CWRA	Canadian Water Resources Association
CWWA	Canadian Water and Wastewater Association
CWS	Canadian Wildlife Service
DCP	Data Collection Platform
DFO	Department of Fisheries and Oceans
DIAND	Department of Indian Affairs and Northern Development
DOA	Department of Agriculture
DOE	Department of Environment
DOT	Department of Transport
DSS	Department of Supply and Services
EARP	Environmental Assessment and Review Process
EMR	Energy Mines and Resources Canada
ERDA	Economic Regional Development Agreement
FA	*Fisheries Act*
FDR	Flood Damage Reduction
FWP	Federal Water Policy
GEMS	Global Environmental Monitoring System
GLWQA	Great Lakes Water Quality Agreement
GNWT	Government of the Northwest Territories
GSC	Geological Survey of Canada
HOMS	Hydrological Operational Multipurpose System
ICW	Interdepartmental Committee on Water
IDRC	International Development Research Centre
IIASA	International Institute for Applied Systems Analysis
IJC	International Joint Commission
IRIA	*International River Improvements Act*
ISTC	Industry Science and Technology Canada
LRTAP	Long Range Transport of Airborne Pollutants
NAQUADAT	National Water Quality Data Base
NASA	National Aeronautical and Space Administration
NAWMP	North American Waterfowl Management Plan
NGO	Non-governmental organization
NHRI	National Hydrological Research Institute

NHW	National Health and Welfare
NIWA	*Northern Inland Waters Act*
NSERC	Natural Sciences and Engineering Research Council
NSI	National Survival Institute
NWPA	*Navigable Waters Protection Act*
NWRI	National Water Research Institute
PERD	Panel on Energy Research and Development
PFRA	Prairie Farm Rehabilitation Administration
PPWB	Prairie Provinces Water Board
Ramsar	The city where the Convention for Wetlands of International Importance was drafted.
R&D	Research and development
SOE	State of Environment
UNEP	United Nations Environment Program
UNICEF	United Nations International Children's Emergency Fund
U.S. EPA	United States Environmental Protection Agency
WAC	Water Advisory Committee of the Canadian Council of Ministers of the Environment
WHO	World Health Organization
WRRSP	Water Resources Research Subventions Program
WTC	Wastewater Technology Centre

APPENDIX B

PRIORITY SUBSTANCES LIST

Group 1:

Arsenic (7440-38-2) and its compounds
Benzene (71-43-2)
Effluents from pulp mills using bleaching
Hexachlorobenzene (118-74-1)
Methyl tertiary-butyl ether (1634-04-4)
Polychlorinated dibenzodioxins
Polychlorinated dibenzofurans
Polycyclic aromatic hydrocarbons
Waste crankcase oils

Group 2:

Cadmium (7440-43-9) and its compounds
Chlorinated wastewater effluents
Chlorobenzene (108-90-7)
Chromium (7440-47-3) and its compounds
Creosote-impregnated waste materials
Dibutyl phthalate (84-74-2)
1,2-Dichlorobenzene (95-50-1)
1,4-Dichlorobenzene (106-46-7)
1,2-Dichloroethane (107-06-2)
Dichloromethane (75-09-2)
Di-n-octyl phthalate (117-84-0)
bis(2-Ethylhexyl) phthalate (117-81-7)
Inorganic fluorides
Nickel (7440-02-0) and its compounds
Pentachlorobenzene (608-93-5)
Styrene (100-42-5)
Tetrachlorobenzenes
1,1,2,2-Tetrachloroethane (79-34-5)
Tetrachloroethylene (127-18-4)
Toluene (108-88-3)
Trichlorobenzenes
1,1,1-Trichloroethane (71-55-6)
Trichloroethylene (79-01-6)
Xylenes (1330-20-7)